(199)

DAC 56182

ENGINEERING TEST TECHNICAL MEMORANDUM

MODEL DSV-4B

QUALIFICATION TEST

SOLENOID VALVE - 1/4 INCH

6000 PSIG

DAC P/N 1A69815-517

DOUGLAS

AIRCRAFT MODIFICATION DIVISION

PREPARED BY: R P Talbott DATE: January 24, 1967
Test Engineer

CHECKED BY: P. D. Ellis APPROVED BY: [signature]
Group Engineer Chief, Engineering Test

DOUGLAS AIRCRAFT COMPANY INC.

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INTRODUCTION

The following information is presented for the purpose of conveying data obtained from testing the Solenoid Valve, DAC P/N 1A69815-511 and -517 prior to successfully completing the specified series of qualification tests. Testing was conducted in six phases. The specimen for Phases I and II was DAC P/N 1A69815-511, and for phases III through VI a DAC P/N 1A69815-517.

Phase I of testing consisted of proof, flow rate/pressure drop, high temperature and low temperature tests. Drop-out voltage was out-of-tolerance during the post proof, post flow, high temperature, post high temperature, low temperature and post low temperature functional tests; insulation resistance was low during the di-electric strength test at high temperature; maximum current draw was high at low temperature; pull-in voltage was high during the post flow functional and de-actuation time was slow at low temperature. The specimen was rejected on FARR Tag D-15329, dated 27 January 1965, and returned to the vendor.

Phase II of testing consisted of proof, flow rate/pressure drop and high temperature tests. Maximum current draw during the post proof functional test was high. At high temperature (+160°F) the specimen would not reseat upon removal of solenoid voltage and subsequently would unseat without the solenoid being energized, resulting in internal leakage. The specimen was rejected on FARR Tag D-16023, dated 11 June 1965, and returned to the vendor.

Phase III of testing consisted of proof and high temperature tests. Maximum current draw was high during the post proof functional test and internal leakage occurred at high temperature. The specimen was rejected on FARR Tag D-16861, dated 13 October 1965, and returned to the vendor.

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Phase IV of testing consisted of a proof test. The pull-in voltage was high during the post proof functional test and the specimen rejected on FARR Tag D-17856, dated 28 January 1966, and returned to the vendor.

Phase V of testing consisted of proof, flow rate/pressure drop, high and low temperature and humidity tests. Pull-in voltage during the post proof functional test was high and was adjusted by a vendor representative. The "open" position switch did not operate during the low temperature or post low temperature functional tests and was adjusted. Pull-in voltage was high during the post humidity functional test. The specimen was rejected on FARR Tag D-25536, dated 16 May 1966, and returned to the vendor.

Phase VI of testing was initiated with a proof and humidity test. Pull-in voltage was high during the post humidity functional test and the specimen was rejected on FARR Tag D-21248, dated 16 August 1966, and returned to the vendor.

Upon return from the vendor, the humidity and continuous duty tests were performed. The "open" position switch required adjustment after humidity and an internal leak occurred during the post continuous duty functional test. The valve seat and an O-ring were replaced by a vendor representative and the proof, flow rate/pressure drop and continuous duty tests repeated. The "closed" position switch failed to operate during the post continuous duty functional test and was adjusted. Life cycle and burst tests completed the testing.

The remainder of this report covers in detail a complete test sequence, the results of which were within the required parameters. High and Low Temperature tests were performed in Phase V and the remainder in Phase VI.

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1.0 TEST PART

One Solenoid Valve, 6000 psig, 1/4-inch, DAC P/N 1A69815-517, Revision AB.

Vendor:	Vacco Valve Company El Monte, California
Vendor P/N:	SSD6P1-41MSA
Vendor S/N:	10236-21 (R-5)

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2.0 TEST INSTRUMENTATION

See Figure 1 for a list of instrumentation certified traceable to the National Bureau of Standards.

3.0 TEST REQUIREMENTS

3.1 General

Photographs of the test specimen, both assembled and disassembled, and all test setups shall be made.

A visual inspection shall be performed following each test to determine any evidence of damage or failure to the test specimen.

3.2 Standard Conditions

Unless otherwise specified, all tests shall be conducted at the ambient conditions defined below:

a. Temperature: $77^{\circ} \pm 18^{\circ}F$
b. Relative Humidity: 90% or less
c. Barometric Pressure: 28 to 32 in.Hg

3.3 Test Media

The test media shall be:

a. Nitrogen gas per MIL-P-27401, 25 micron absolute filtered.
b. Helium gas, Grade A, Bureau of Mines, 25 micron absolute filtered.
c. Tap water or hydraulic fluid per MIL-H-6083.
d. Leak Test Solution, AMS 3159 or equivalent.
e. Leak Test Solution, MIL-L-25567A, Type II, DPM 2286.

3.4 Environmental Tolerances

Unless otherwise specified, the maximum allowable deviations from the specified environmental conditions are as follows:

a. Temperature $\pm 4^{\circ}F$
b. Flow $\pm 8\%$
c. Pressure $\pm 2\%$
d. Electrical $\pm 2\%$
e. Humidity $\pm 5\%$

3.5 Measurement Tolerances

Unless otherwise specified, all measurements shall be made with instruments whose accuracy has been verified to the following tolerances:

a. Temperature ± 2°F
b. Flow ± 4%
c. Pressure ± 1%
d. Electrical ± 1%
e. Humidity ± 2-1/2%

3.6 Pre-Test Inspection

Prior to test, a visual inspection shall be performed to verify that the part is free from damage.

The DAC P/N, change letter, dash number, vendor, vendor P/N, serial number, and all other pertinent information shall be recorded.

3.7 Proof Test

The proof test shall be conducted using ambient gaseous nitrogen gradually applied simultaneously to the inlet and outlet ports of the specimen until a pressure of 9,000 $^{+200}_{-0}$ psig is reached. This proof pressure shall be held for two minutes. There shall be no visual evidence of damage, failure or distortion.

3.8 Functional Test

A functional test, consisting of all items specified in this paragraph (3.8) excpet di-electric strength, paragraph 3.8.3, shall be performed under standard conditions on the specimen before and after each environmental test. The di-electric strength will be performed only during the initial functional test and at the completion of the continuous duty test.

3.8.1 External Leak Test

The external leak test shall be conducted using ambient gaseous helium. The helium pressure shall be gradually applied simultaneously to the inlet and outlet ports until 6000 ± 120 psig is reached.

AMS 3159 or equivalent bubble solution shall be applied to the specimen to check for bubble-tight external leakage. Bubble-tight leakage is defined as no evidence of leakage of the working medium.

The leak check shall be made with the solenoid de-energized.

3.8.2 Internal Leak Test

The internal leak test shall be conducted using ambient gaseous helium. With the solenoid de-energized, helium pressure shall be gradually applied to the inlet port until 6000 ± 120 psig is reached.

There shall be no evidence of leakage across the specimen.

3.8.3 Di-Electric Strength Test

With the inlet port pressurized to 6000 ± 120 psig of ambient gaseous nitrogen, an AC voltage shall be applied between the specimen body and pins A, B, and C of both electrical connectors for a minimum period of one minute each. There shall be no evidence of electrical breakdown. The applied voltages shall be 1000 ± 50 VAC RMS for the initial test and 900 ± 50 VAC RMS after the continuous duty test.

3.8.4 Maximum Current Draw Test

The maximum current draw test shall be conducted with the inlet port of the specimen pressurized to 6000 ± 120 psig with ambient gaseous nitrogen.

The solenoid of the specimen shall be energized with 24 ± 1 VDC. The current draw shall not exceed 1.5 amperes at an ambient temperature of $70 \begin{smallmatrix}+10\\-0\end{smallmatrix}$ °F.

3.8.5 Pull-In Voltage Test

The pull-in voltage test shall be conducted with the inlet port of the specimen pressurized to 6000 ± 120 psig with ambient gaseous nitrogen.

A gradually increasing voltage shall be imposed on the solenoid of the specimen until actuation occurs. This voltage level shall be recorded and shall not exceed 18 VDC at the time of actuation.

3.8.6 Drop-Out Voltage Test

The drop-out voltage test shall be conducted with the inlet port of the specimen pressurized to 6000 ± 120 psig with ambient gaseous nitrogen.

With 28 ± 1 VDC imposed on the energized solenoid of the specimen, the voltage level shall be gradually reduced until de-actuation occurs. This drop-out voltage shall be 5 ± 3 VDC.

3.8.7 Actuation Time Test

The actuation time test shall be conducted with the inlet port of the specimen pressurized to 6000 ± 120 psig with ambient gaseous nitrogen.

The specimen solenoid shall be energized with 28 ± 1 VDC and the time required for valve actuation recorded. The solenoid voltage shall then be removed and valve de-actuation time recorded. Maximum time for each operation shall be 250 milliseconds.

This test shall be accomplished five times.

3.8.8 Valve Position Switch Test

The valve position switch test shall be conducted with the inlet port of the specimen pressurized to 6000 ± 120 psig with ambient gaseous nitrogen.

3.8.8 Valve Position Switch Test (Continued)

A voltage of 32 $^{+0}_{-1}$ VDC with current flow controlled to 2 $\pm$ 1/2 amperes shall be imposed on the common lead of the valve position switch receptacle.

The normally open and normally closed position leads shall be monitored for correct valve position indication.

3.9 Flow Rate/Pressure Drop Test

The flow rate/pressure drop test shall be conducted with ambient gaseous nitrogen applied to the inlet port of the specimen and the solenoid energized.

With an inlet pressure of 6,000 psig and a minimum flow rate of 25 SCFM, the pressure drop across the specimen shall be determined. The maximum allowable pressure drop shall be 480 psi..

Pressure drops shall also be determined with inlet pressures and minimum flow rates of 5250 psig, 16.3 SCFM; 4500 psig, 10.6 SCFM; 3750 psig, 5.3 SCFM; 3000 psig, 3.4 SCFM; 2250 psig, 2.2 SCFM; 1500 psig, 1.4 SCFM; and 750 psig, 0.9 SCFM.

The maximum allowable pressure drop across the specimen shall be 8% of the applied inlet pressure.

3.10 High Temperature Test

The test specimen shall be placed in an environmental chamber and the internal temperature raised to 130°F with a relative humidity of not more than 15%. These conditions shall be maintained for 48 hours or until the specimen becomes stabilized at 130°F, whichever occurs first.

While at this temperature, complete functional tests shall be performed.

The specimen shall be allowed to return to ambient temperature conditions. The functional tests shall be repeated.

3.11 Low Temperature Test

The test specimen shall be placed in a temperature environmental chamber and the internal temperature lowered to 0°F. This temperature shall be maintained for 48 hours or until the specimen becomes stabilized at 0°F, whichever occurs first.

While at this temperature, complete functional tests shall be performed.

The specimen shall be allowed to return to ambient temperature conditions. The functional tests shall be repeated.

3.12 Humidity Test

The test specimen shall be placed in a vented environmental chamber with a temperature of 84 ± 16°F.

Steam or distilled water having a pH value between 6.5 and 7.2 at 77°F shall be used to obtain the desired humidity, and the velocity of air through the test chamber shall not exceed 150 feet per minute.

The first two hours of testing shall consist of gradually elevating the chamber temperature to 160°F and the relative humidity to 95 ± 5%. These conditions shall be maintained for six hours. The next sixteen hours shall consist of gradually lowering the chamber temperature to 84 ± 16°F while retaining the relative humidity at 95 ± 5%.

The above shall be defined as one humidity cycle. Ten complete humidity cycles shall be performed without interruption for a total of 240 continuous hours of testing.

At the conclusion of 240 hours, complete functional tests shall be performed.

3.13 Continuous Duty Test

The specimen shall have 28 ± 1 VDC applied to the solenoid and the valve position switch continuously for a minimum period of 24 hours.

3.13 Continuous Duty Test (Continued)

The valve position switch shall indicate the correct valve position and the maximum current draw of the solenoid shall be 1.5 amperes throughout the test.

Upon completion of the 24-hour period, 6,000 ± 120 psig of ambient gaseous nitrogen shall be applied to the inlet port and 25 actuation/de-actuation cycles performed. The valve position switch shall correctly indicate valve position and steady state current draw shall not exceed 1.5 amperes.

3.14 Life Cycle Test

The inlet port of the specimen shall be pressurized with 6000 ± 120 psig of ambient gaseous nitrogen. The specimen shall then be subjected to 2,500 operational cycles by the application and removal of 28 ± 1 VDC to the solenoid. A minimum flow of 4 SCFM shall be maintained while energized.

A complete functional test as described in paragraph 3.8 shall be performed at the completion of each 500 cycles.

3.15 Burst Test

Hydrostatic pressure shall be gradually applied simultaneously to the inlet and outlet ports until the specimen is ruptured or the minimum burst pressure of 24,000 psig is reached and maintained for a period of two minutes.

The specimen body shall remain intact.

3.16 Post Test Inspection

After completion of testing, the specimen shall be disassembled and inspected for evidence of damage or excessive wear.

4.0 TEST SETUP AND PROCEDURE

4.1 General

Prior to each test, the ambient conditions were measured and recorded. All tests were performed with the media specified in Paragraph 3.3.

4.2 Pre-Test Inspection

The test specimen was inspected for any visual evidence of damage prior to test.

The DAC part number, change letter, dash number, vendor, vendor part number, and other pertinent information were recorded.

Photograph 1 shows the test specimen prior to test.

4.3 Proof Test

The proof test was conducted using ambient gaseous nitrogen as the test media. Pressure was slowly applied simultaneously to the inlet and outlet ports of the specimen until 9100 psig was reached. This pressure was maintained for two minutes.

The test specimen was visually inspected for evidence of failure or damage.

Photograph 2 shows a typical proof test setup.

Photograph 3 shows the pressure gauge used for the proof test.

4.4 Functional Test

A functional test consisting of external leak, internal leak, maximum current draw, pull-in voltage, drop-out voltage, actuation time and valve position switch tests was conducted before and after the flow, humidity, and continuous duty tests, and before, during and after the high temperature, low temperature, and life cycle tests.

4.4 Functional Test (Continued)

In addition, a di-electric strength test was performed during the initial functional test and after the continuous duty test.

Photographs 3 and 4 show the instrumentation used for a typical functional test series.

4.4.1 External Leak Test

The external leak test was conducted with ambient gaseous helium as the test media. Pressure was gradually applied to the inlet and outlet ports until 6000 psig was reached.

AMS 3159 bubble solution was applied to external surfaces of the test specimen to check for bubble-tight leakage.

The specimen was visually inspected for evidence of failure or damage.

Photograph 2 shows a typical external leak test setup.

4.4.2 Internal Leak Test

The internal leak test was conducted with ambient gaseous helium as the test media. With the solenoid de-energized, pressure was gradually applied to the inlet port until 6000 psig was reached.

A graduated cylinder and beaker of water was used to measure leakage through the outlet port.

The specimen was visually inspected for evidence of failure or damage.

Photograph 5 shows a typical internal leak test setup.

4.4.3 Di-Electric Strength Test

With 6000 psig of ambient gaseous nitrogen applied to the inlet port, the insulation resistance was checked at the solenoid receptacle with a non-destructive insulation tester.

4.4.3 Di-Electric Strength Test (Continued)

One thousand VAC RMS was imposed between pins A, B, and C of the solenoid receptacle and the specimen body for one minute.

Insulation resistance was again checked and the results compared with the previous reading.

The di-electric strength test was performed on the micro-switch receptacle using the same procedure specified above.

Photographs 4 and 6 show a typical setup which was common to tests specified in paragraphs 4.4.3 through 4.4.8.

4.4.4 Maximum Current Draw Test

The maximum current draw test was conducted using ambient gaseous nitrogen as the test media. Pressure was gradually applied to the inlet port until 6000 psig was reached.

The solenoid was energized with 24 VDC and maximum current draw measured and recorded.

4.4.5 Pull-In Voltage Test

The pull-in voltage test was conducted using ambient gaseous nitrogen as the test media. Pressure was gradually applied to the inlet port until 6000 psig was reached.

A DC voltage, gradually increasing from zero VDC, was applied to the solenoid of the specimen until actuation occurred. The pull-in voltage was measured and recorded.

4.4.6 Drop-Out Voltage Test

Pressure conditions described in Paragraph 4.4.5 were continued with the solenoid voltage increased to 28 VDC.

The solenoid voltage was slowly decreased until de-actuation occurred. The drop-out voltage was measured and recorded.

4.4.7 Actuation Time Test

Pressure conditions described in Paragraph 4.4.5 were continued for the actuation time test.

The solenoid of the specimen was energized with 28 VDC and actuation time measured and recorded on an oscillograph. The voltage was then removed and de-actuation time measured and recorded. This test was accomplished a total of five times.

4.4.8 Valve Position Switch Test

Pressure conditions described in Paragraph 4.4.5 were continued for the valve position switch test.

A voltage of 31 VDC was imposed on the common lead of the valve position switch receptacle with a controlled current of 2 amperes.

The voltage across the normally open and normally closed contacts was monitored with the solenoid both energized and de-energized to verify proper operation of the valve position switch.

The test specimen was visually inspected for evidence of failure or damage.

4.5 Flow Rate/Pressure Drop Test

The flow rate/pressure drop test was conducted using ambient gaseous nitrogen as the test media.

Pressure drops across the specimen were determined for inlet pressures and flow rates specified in Paragraph 3.9.

The specimen was visually inspected for evidence of failure or damage.

Photographs 7 and 8 show a typical flow rate/pressure drop test setup. Photograph 9 shows the test instrumentation.

4.6 High Temperature Test

The high temperature test was conducted in an environmental test chamber.

The interior of the test chamber was brought to 130°F with a relative humidity of less than 15% and maintained until the specimen stabilized at this temperature.

Functional tests were performed, the specimen returned to ambient conditions and the functional tests repeated.

The specimen was visually inspected for evidence of failure or damage.

Photograph 10 shows the specimen in the environmental chamber.

Photograph 3 shows the instrumentation used for this test.

4.7 Low Temperature Test

The low temperature test was conducted in an environmental test chamber.

The interior of the test chamber was brought to 0°F and maintained until the specimen stabilized at this temperature.

Functional tests were performed, the specimen returned to ambient conditions and the functional tests repeated.

MIL-L-25567A, Type II, leak test solution was used on the 0°F external leak test.

The specimen was visually inspected for evidence of failure or damage.

Photograph 10 shows the specimen in the environmental chamber.

Photograph 3 shows the instrumentation used for this test.

4.8 Humidity Test

The humidity test was conducted in a vented environmental chamber.

Ten test cycles as specified in paragraph 3.12 were accomplished.

Steam, with a pH value of 6.65 was used to obtain a relative humidity of 95%.

Complete functional tests were performed at the conclusion of 240 continuous hours of exposure to humidity.

Photograph 11 shows the specimen in the environmental chamber.

The specimen was visually inspected for evidence of failure or damage.

4.9 Continuous Duty Test

The continuous duty test was conducted with 28 VDC applied to the solenoid of the specimen for 24 hours.

Current draw was monitored throughout this period to ensure that 1.5 amperes was not exceeded and the valve position switch monitored for evidence of proper operation.

At the conclusion of the 24-hour test period, 6000 psig of ambient gaseous nitrogen was applied to the inlet port and 25 actuation/de-actuation cycles performed while monitoring the valve position switch indicator.

The specimen was visually inspected for evidence of damage or failure.

Photograph 12 shows the specimen in the continuous duty test setup.

4.10 Life Cycle Test

The life cycle test was conducted using ambient gaseous nitrogen as the test media.

4.10 Life Cycle Test (Continued)

The test setup provided the means to supply nitrogen pressure as required and a method to alternately energize and de-energize the solenoid at a controlled rate.

The specimen was subjected to 2500 operational cycles with 6000 psig of nitrogen applied to the inlet port.

A complete functional test, as detailed in paragraph 4.4, was performed at the conclusion of each 500 cycles.

The specimen was visually inspected for evidence of failure or damage.

Photograph 13 shows the specimen in the life cycle setup.

4.11 Burst Test

The burst test was conducted using hydraulic fluid as the test media.

Pressure was gradually increased simultaneously to the inlet and outlet ports until 24,200 psig was reached and maintained for over two minutes.

The specimen was visually inspected for evidence of failure or damage.

Photograph 2 shows the specimen in the burst test setup.

Photograph 14 shows the burst test pressure panel.

4.12 Post Test Inspection

The test specimen was disassembled and inspected for excessive damage or wear. Photograph 15 was made prior to re-assembly.

5.0 TEST RESULTS

5.1 General

In all tests, the ambient conditions were within the limits specified in Paragraph 3.2.

No evidence of damage or failure, except as noted, was observed when the specimen was visually inspected following each test.

5.2 Pre-Test Inspection

The test specimen was visually inspected and found to be free of damage and was properly designated as to part number, form and configuration. The results were as follows:

Douglas P/N:	1A69815-517, Rev. AB
Vendor:	Vacco Valve Company
	El Monte, California
Vendor P/N:	SSD6P1-41MSA
Vendor S/N:	10236-21 (R-5)

5.3 Proof Test

No distortion or failure of any kind was noted when gaseous nitrogen at 9100 psig was applied to the inlet and outlet ports for a period of two minutes.

5.4 Functional Test

Functional test results are tabulated in Figure 2.

5.5 Flow Rate/Pressure Drop Test

The flow rates and pressure drops across the specimen at the specified inlet pressures are shown in Figure 3.

5.6 High Temperature Test

Results of the high temperature and ambient Functional Tests will be found in Figure 2.

5.7 Low Temperature Test

Results of the low temperature and ambient Functional Tests will be found in Figure 2.

5.8 Humidity Test

Results of the Functional Tests following 240 continuous hours in a high-humidity atmosphere will be found in Figure 2.

5.9 Continuous Duty Test

The valve position switch gave proper indication and the current draw of the solenoid ranged between 1.46 and 1.12 amperes throughout the 24-hour period of the continuous duty test.

Maximum current draw of the solenoid was 1.32 amperes during the 25 actuation/de-actuation cycles following the continuous duty test. The closed position switch indicated the specimen was de-energized continuously and was adjusted following the post continuous duty functional test.

5.10 Life Cycle Test

The specimen completed 2500 actuation/de-actuation cycles without any indication of damage or improper operation.

Results of the functional tests performed at the completion of each 500 cycles will be found in Figure 2.

5.11 Burst Test

Visual inspection revealed no distortion or damage to the specimen after pressurization to 24,200 psig.

5.12 Post Test Inspection

Upon completion of testing, the specimen was disassembled, inspected, and photographed. There was no visible evidence of damage.

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TEST INSTRUMENTATION - CERTIFIED
TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS

No.	Part Name	Manufacturer	Model/Range	Serial No.	Latest Calibration Date	Accuracy
1	Pressure Gauge	Heise Co.	30,000 PSI	H38340R	12-13-66	± 0.5% F.S.
2	Pressure Gauge	Heise Co.	10,000 PSI	H38341	9-15-66	± 0.5% F.S.
3	Pressure Gauge	Ashcroft	10,000 PSI	--	8-12-66	± 0.5% F.S.
4	Oscillograph	Century	408	261	9-27-66	± 0.01% F.S.
5	Insulation Tester	Arizona Inst.	7E	--	9-28-66	± 5% F.S.
6	Temperature Recorder	Minneapolis-Honeywell	Y153X(67)P6-X-(107)	810773	8-16-66	± 2°F
7	Temperature Recorder	Minneapolis-Honeywell	Y153X(67)P6-X-(107)	810771	9-21-66	± 2°F
8	Orifice Meter	Daniel	700	--	10-29-65	Certified per AGA Report #3
9	DC Voltmeter	Weston	931	22324	7-20-66	± 0.5% F.S.
10	Milliammeter	Weston	931	6755	7-20-66	± 0.5% F.S

FIGURE 1

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FUNCTIONAL TEST RESULTS

Unless indicated otherwise, the external leak, internal leak and position switch tests performed as part of each functional test series and the di-electric strength tests met the specified requirements.

Functional Test Series	Refer to Notes:	Max. Current Draw (Amps)	Voltage (D.C.)		Time (Milliseconds)	
			Pull-In	Drop-Out	Actuate	De-Actuate
Post Proof-Pre Flow Rate/ Pressure Drop		1.25	14.0	3.2	59-67	26-29
Post Flow Rate/Pressure Drop		1.40	13.5	3.0	61-64	30-32
Pre High Temperature		1.30	16.8	3.4	81-104	18-22
At High Temperature		1.25	14.0	3.8	86-100	14-20
Post High Temperature - Pre Low Temperature		1.35	18.0	3.5	86-148	18-20
At Low Temperature ($0^{\circ}F$)	1	1.58	17.0	2.2	82-91	65-67
Post Low Temperature	2	1.35	17.8	3.5	70-73	29-32

NOTES: 1. The specimen "open" position switch did not indicate. No adjustment was made at this time.

2. The specimen "open" position switch did not indicate. The switch was adjusted for proper operation per A3-860 instructions.

FUNCTIONAL TEST RESULTS

(Continued)

Functional Test Series	Refer to Notes:	Max. Current Draw (Amps)	Voltage (D.C.) Pull-In	Voltage (D.C.) Drop-Out	Time (Milliseconds) Actuate	Time (Milliseconds) De-Actuate
Pre Humidity	3	1.30	18.0	4.0	70-74	28-35
Post Humidity	4	1.36	18.0	3.7	76-80	27-31
Pre Continuous Duty		1.40	13.5	3.0	61-64	30-32
Post Continuous Duty-Pre Life Cycle	5	1.36	11.5	3.4	55-56	24-27
Life Cycle -						
After 500 cycles		1.40	12.0	3.4	63-67	21-27
After 1000 cycles		1.40	11.2	3.3	64-67	25-29
After 1500 cycles		1.42	11.5	3.3	65-67	22-24
After 2000 cycles		1.42	11.4	3.5	64-67	26-27
After 2500 cycles		1.42	12.1	3.3	65-70	23-28

NOTES: 3. The specimen "open" position switch operated continuously. No adjustment was made at this time.

4. The specimen "open" position switch operated continuously. The switch was adjusted for proper operation per A3-860 instructions.

5. The specimen "closed" position switch operated continuously. The switch was adjusted for proper operation per A3-860 instructions.

FIGURE 2
Sheet 2 of 2

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FLOW RATE/PRESSURE DROP TEST DATA

Run No.	Inlet Pressure (PSIG)	GN_2 Flow (SCFM)	Pressure Drop (PSID)
1	6000	63.0	26.0
2	5250	54.2	20.5
3	4500	45.4	16.0
4	3750	36.6	12.0
5	3000	26.6	8.0
6	2250	17.8	4.0
7	1500	10.3	2.0
8	750	5.4	1.0

FORM [illegible]-611C (REV. 4-58)

FIGURE 3

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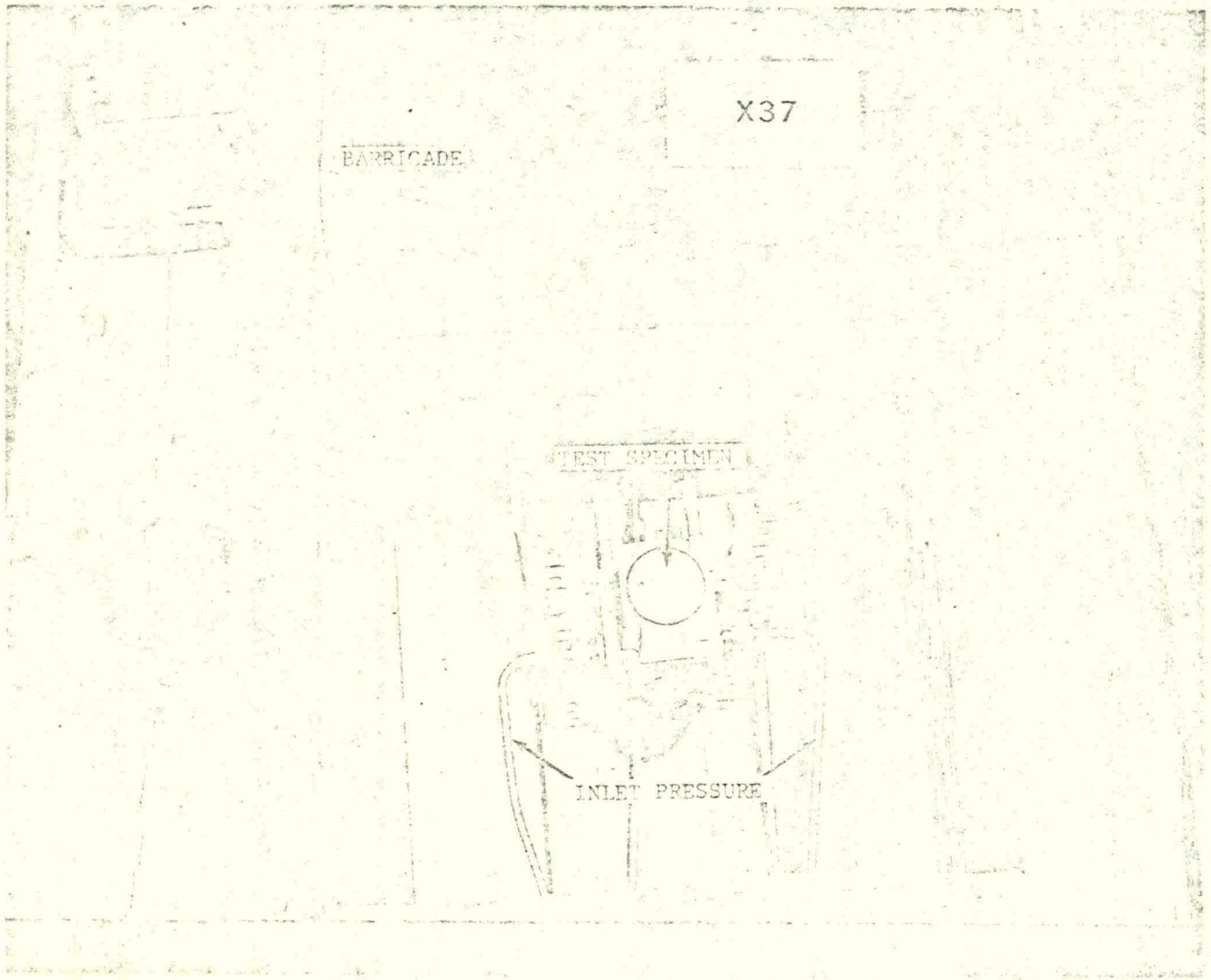
X37

TEST SPECIMEN PRIOR TO TEST

FILM T-30837

PHOTOGRAPH 1



TYPICAL PROOF, EXTERNAL LEAK AND BURST TEST SETUP

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DAC 56132

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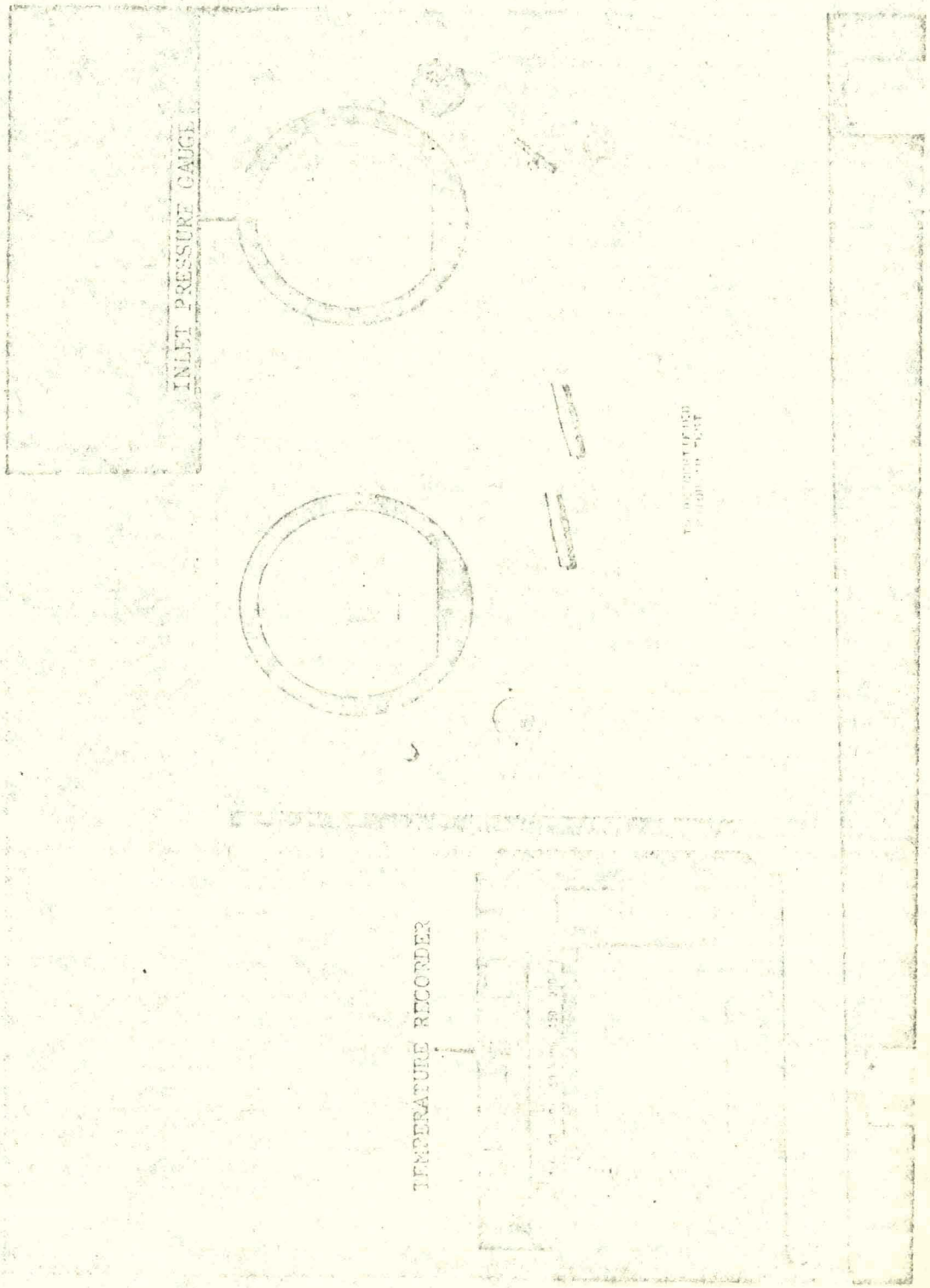
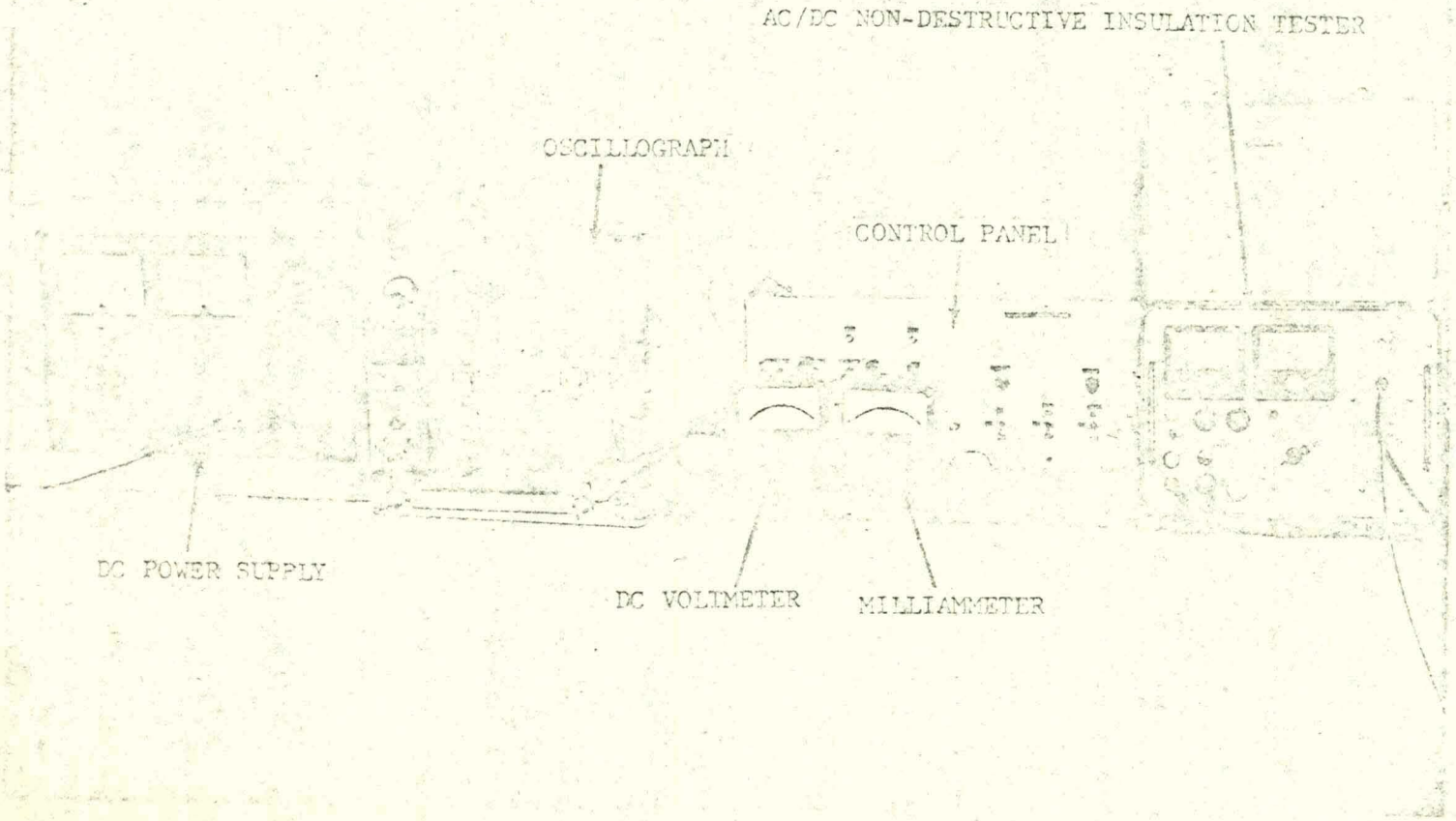


TYPICAL PRESSURE/TEMPERATURE TEST INSTRUMENTATION

FILM T-33614

PHOTOGRAPH 3

FILM T-30907



TYPICAL ELECTRICAL TEST INSTRUMENTATION

PHOTOGRAPH 4

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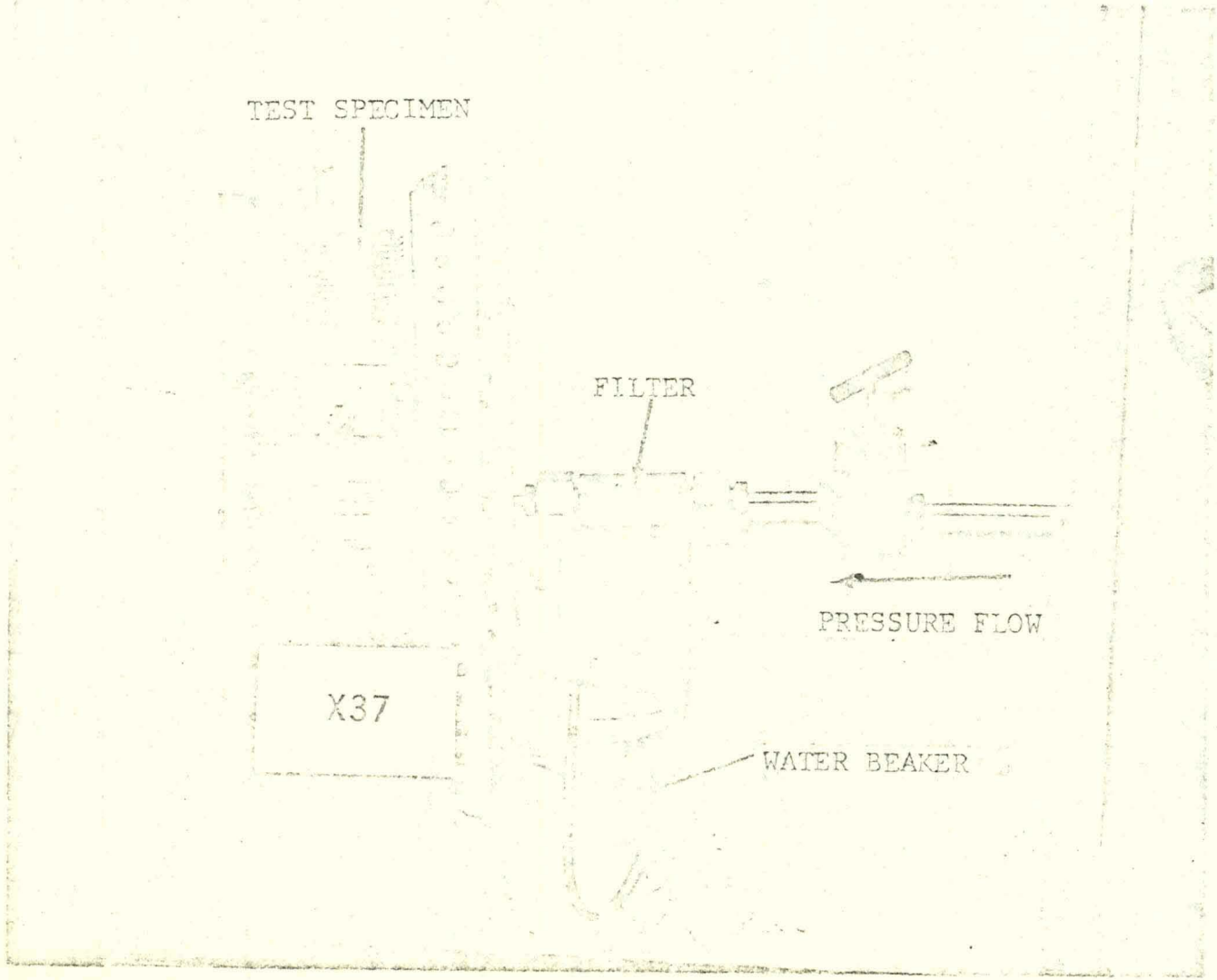
FILM T-28767

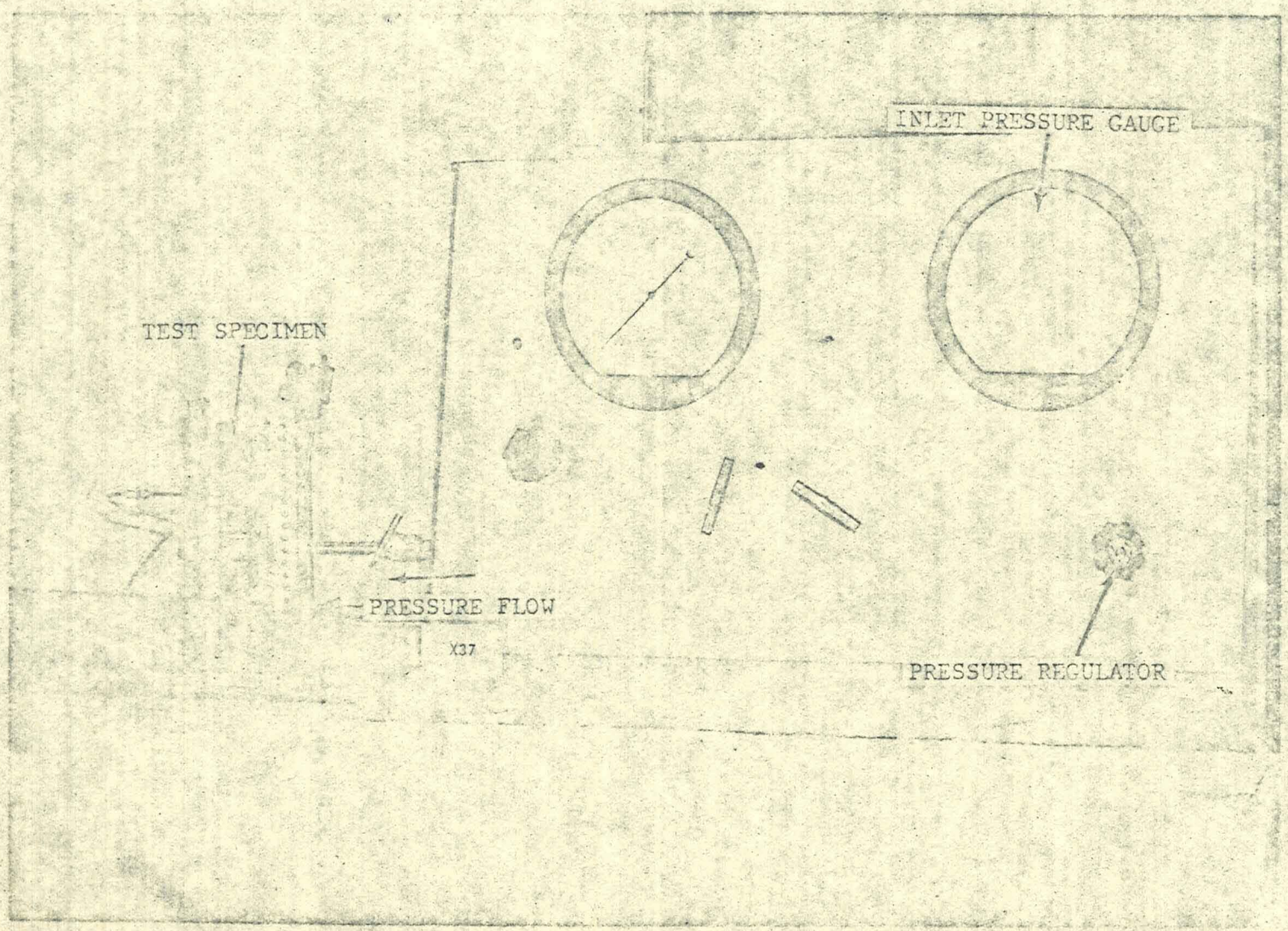


TYPICAL INTERNAL LEAK TEST SETUP

PHOTOGRAPH 5

DOUGLAS
AIRCRAFT MODIFICATION DIVISION

DAC 56182



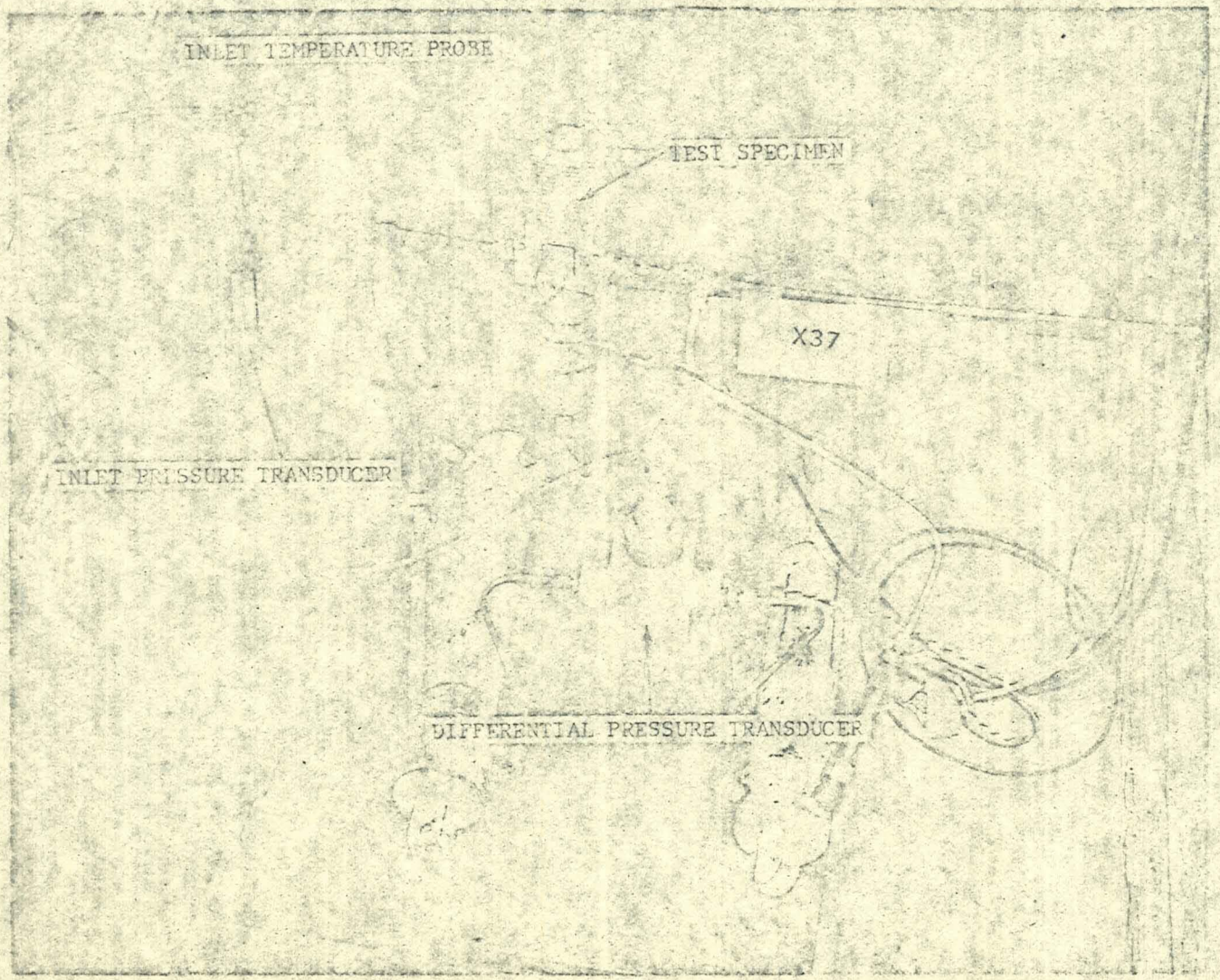
TYPICAL ELECTRICAL TEST SETUP

FILM T-30894

PHOTOGRAPH 6

DOUGLAS AIRCRAFT MODIFICATION DIVISION

DAC 56182



FLOW RATE/PRESSURE DROP TEST SETUP - SPECIMEN

FILM T-31285

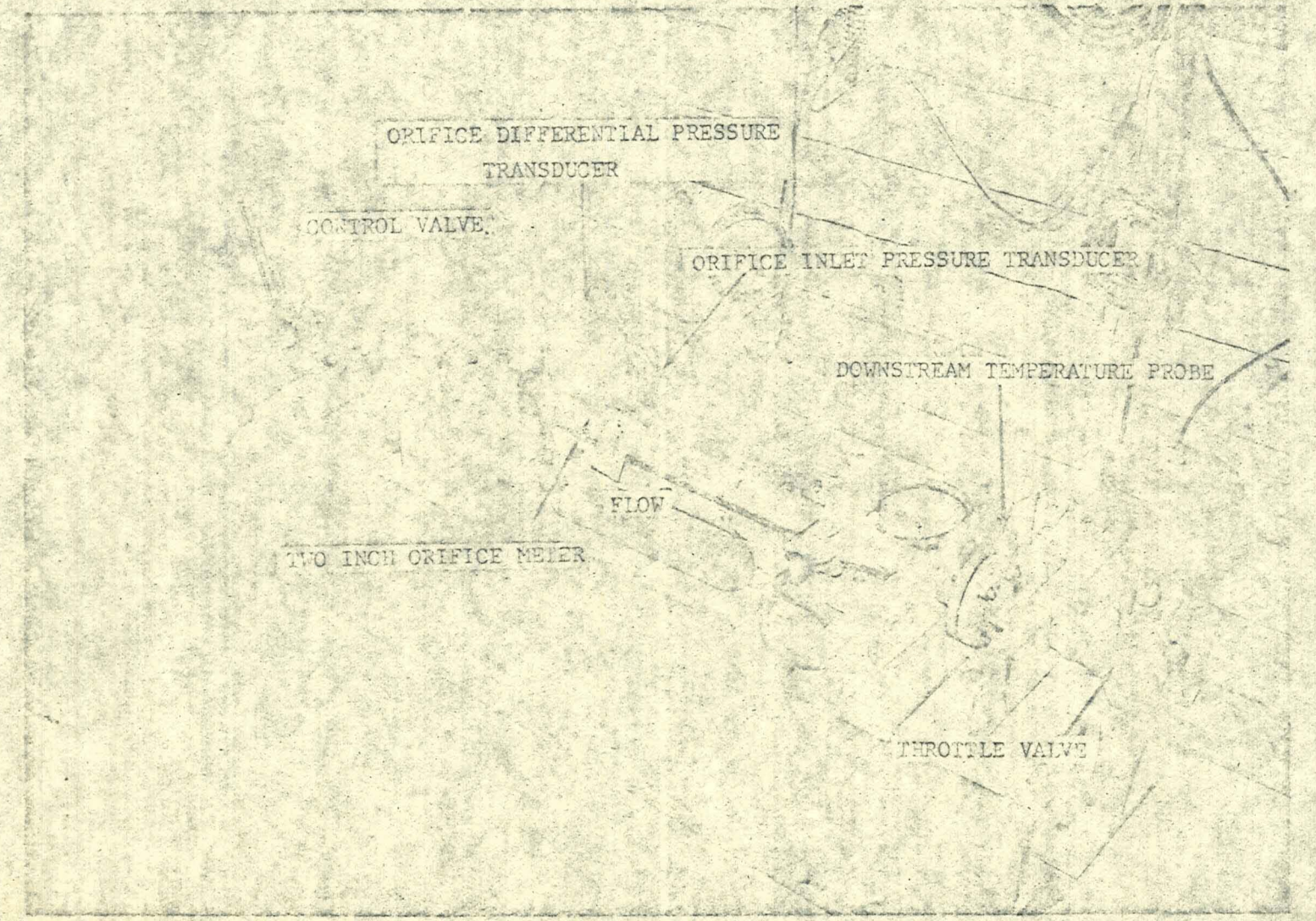
PHOTOGRAPH 7

DOUGLAS

AIRCRAFT MODIFICATION DIVISION

DAC 56182

FILM T-33438

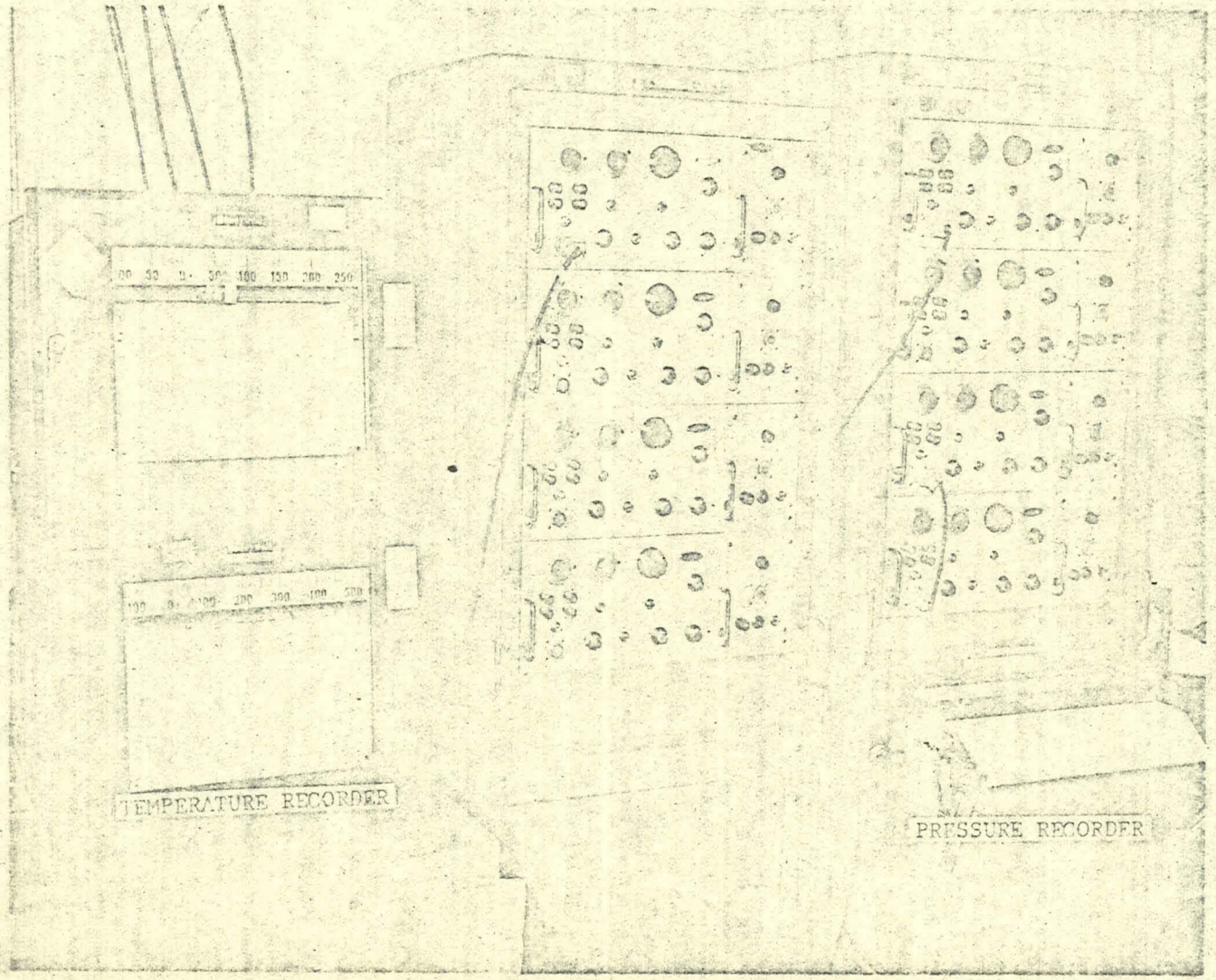


FLOW RATE/PRESSURE DROP TEST SETUP - FACILITY

PHOTOGRAPH 8

DOUGLAS AIRCRAFT MODIFICATION DIVISION

DAC 56182



FLOW RATE/PRESSURE DROP TEST INSTRUMENTATION

FILM T-28512

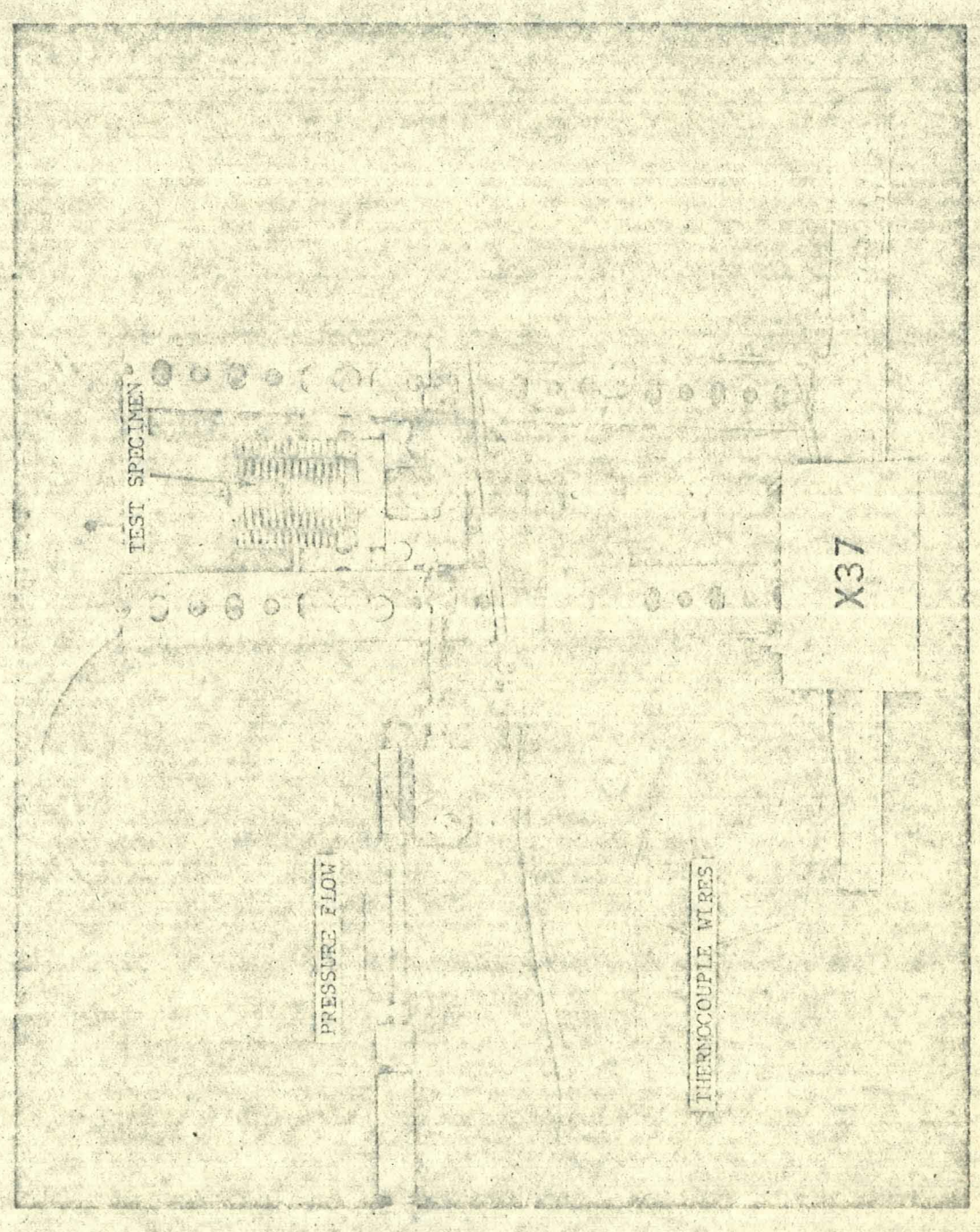
PHOTOGRAPH 9

DOUGLAS

AIRCRAFT MODIFICATION DIVISION

DAC 56182

DOUGLAS
AIRCRAFT MODIFICATION DIVISION

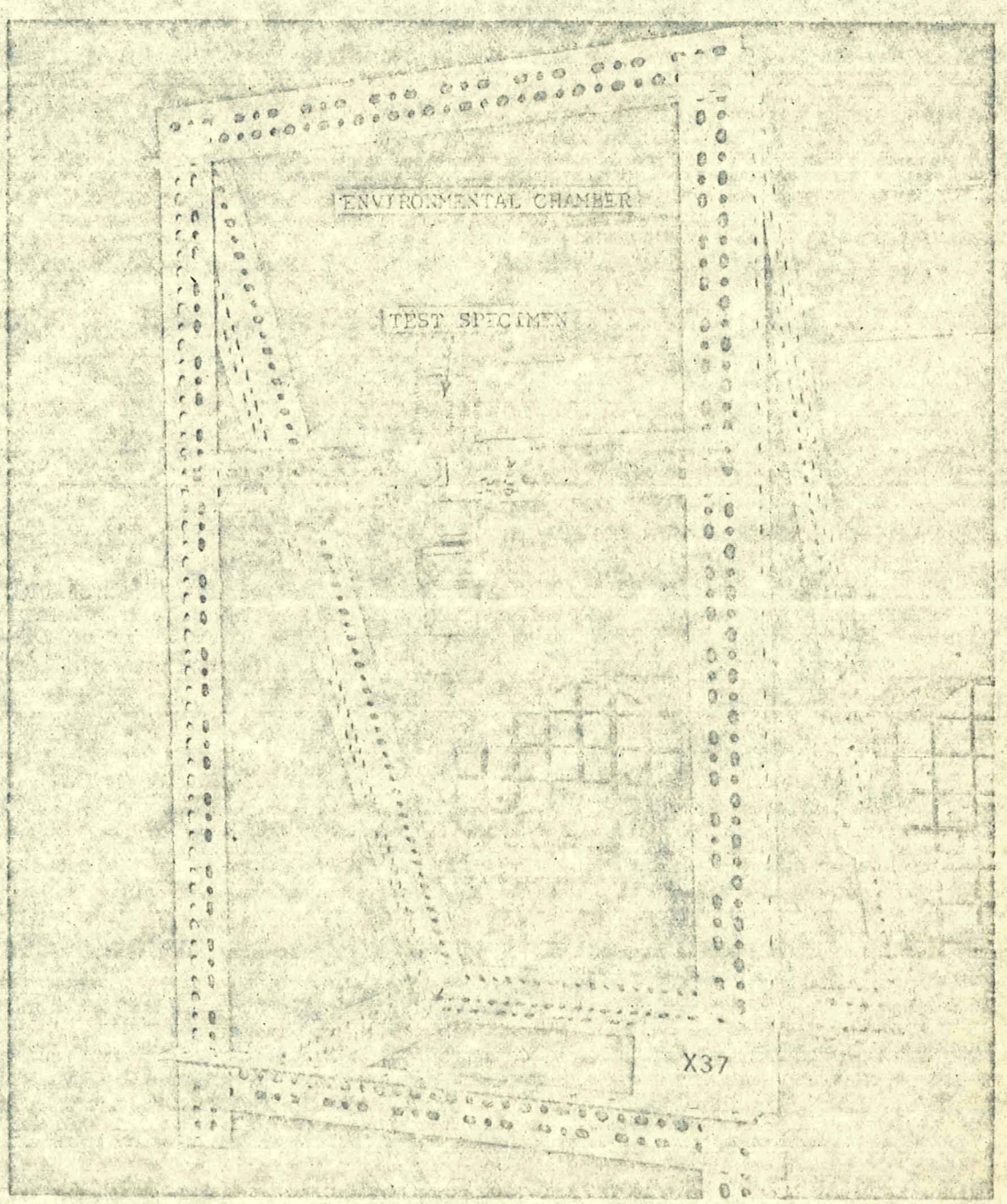


HIGH/LOW TEMPERATURE TEST SETUP

FILM T-29286

PHOTOGRAPH 10

DOUGLAS
AIRCRAFT MODIFICATION DIVISION

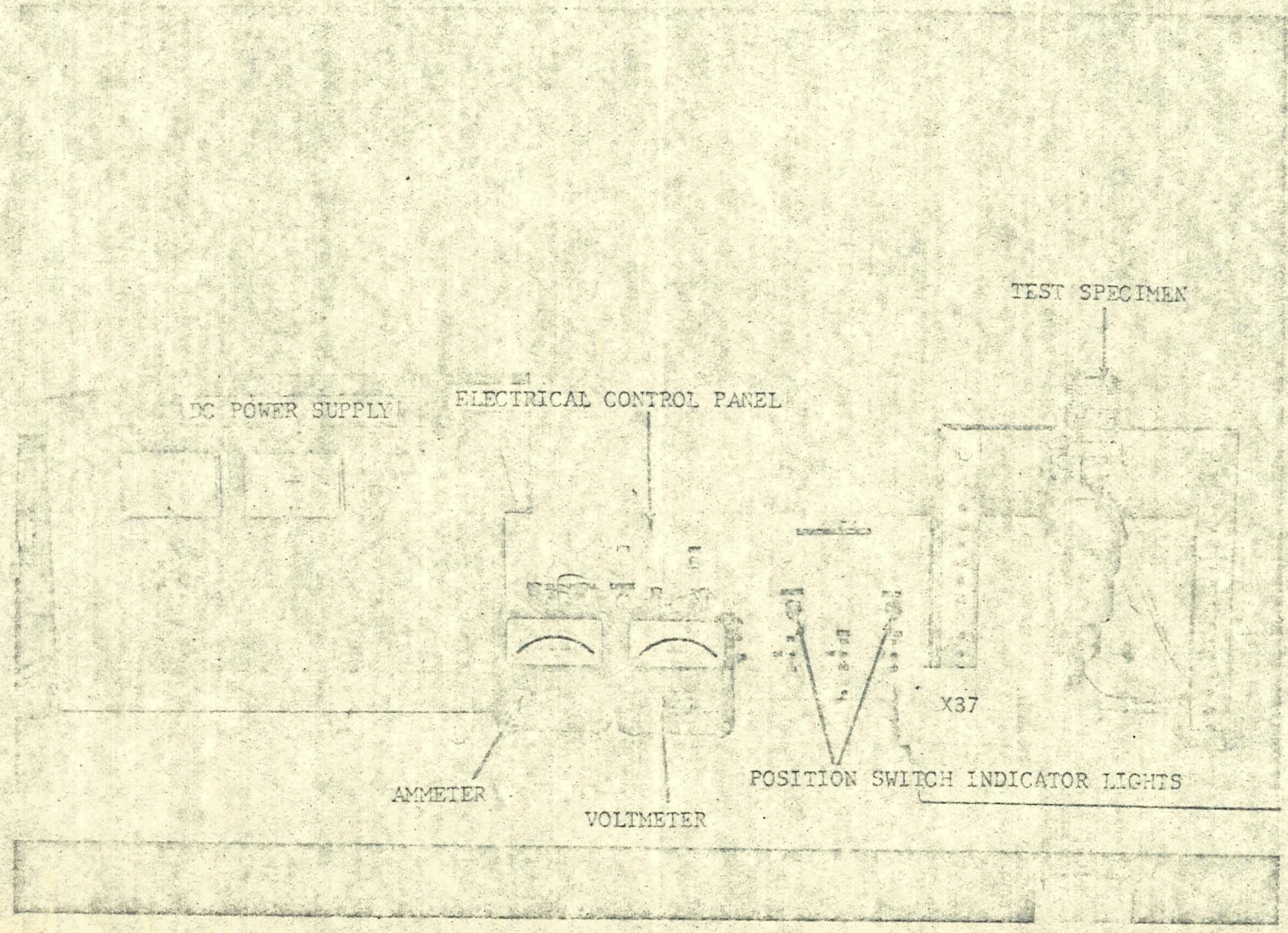


HUMIDITY TEST SETUP

FILM T-35114

PHOTOGRAPH 11

FILM T-36873



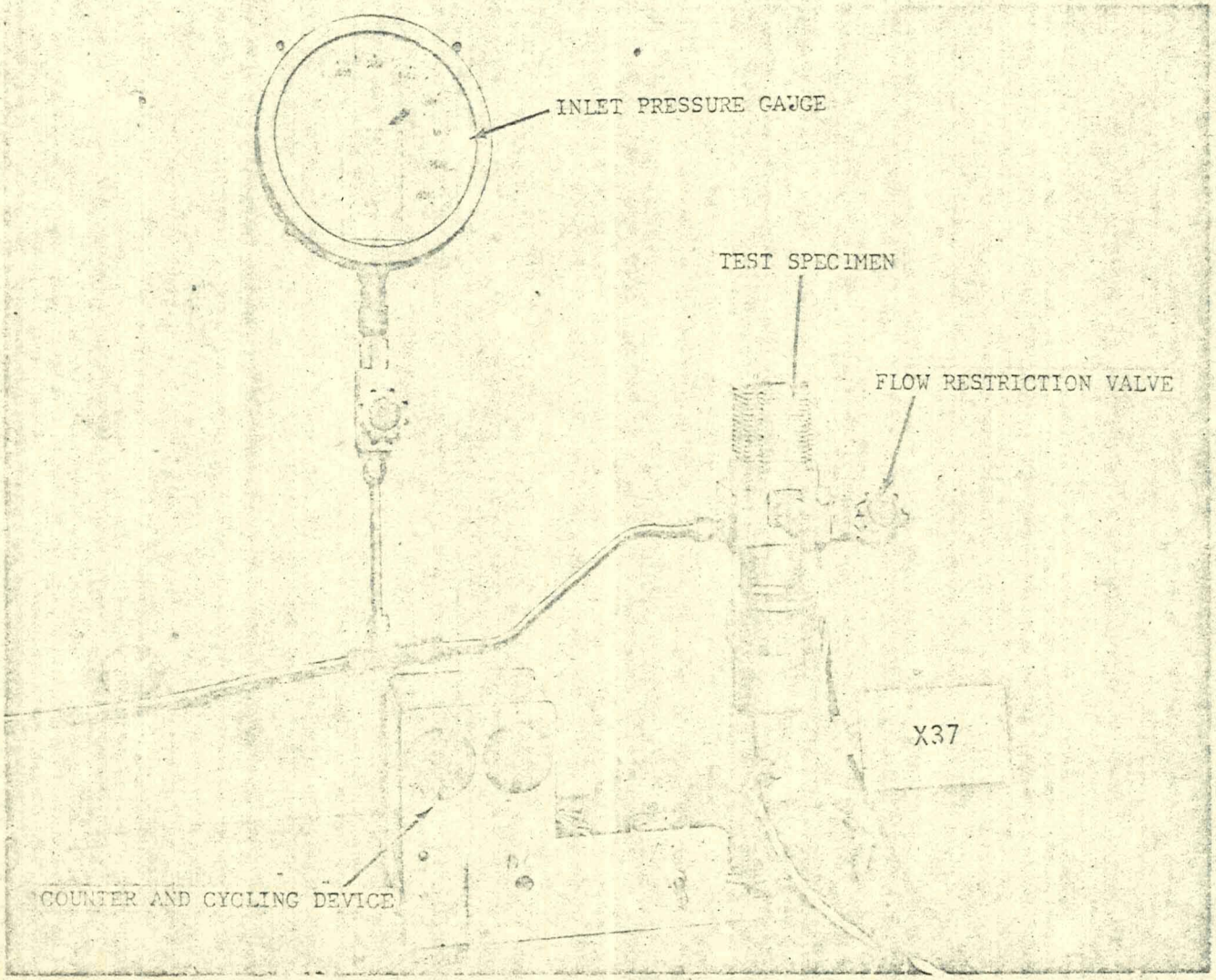
CONTINUOUS DUTY TEST SETUP

PHOTOGRAPH 12

DOUGLAS AIRCRAFT MODIFICATION DIVISION

DAC 56182

FILM T-37647



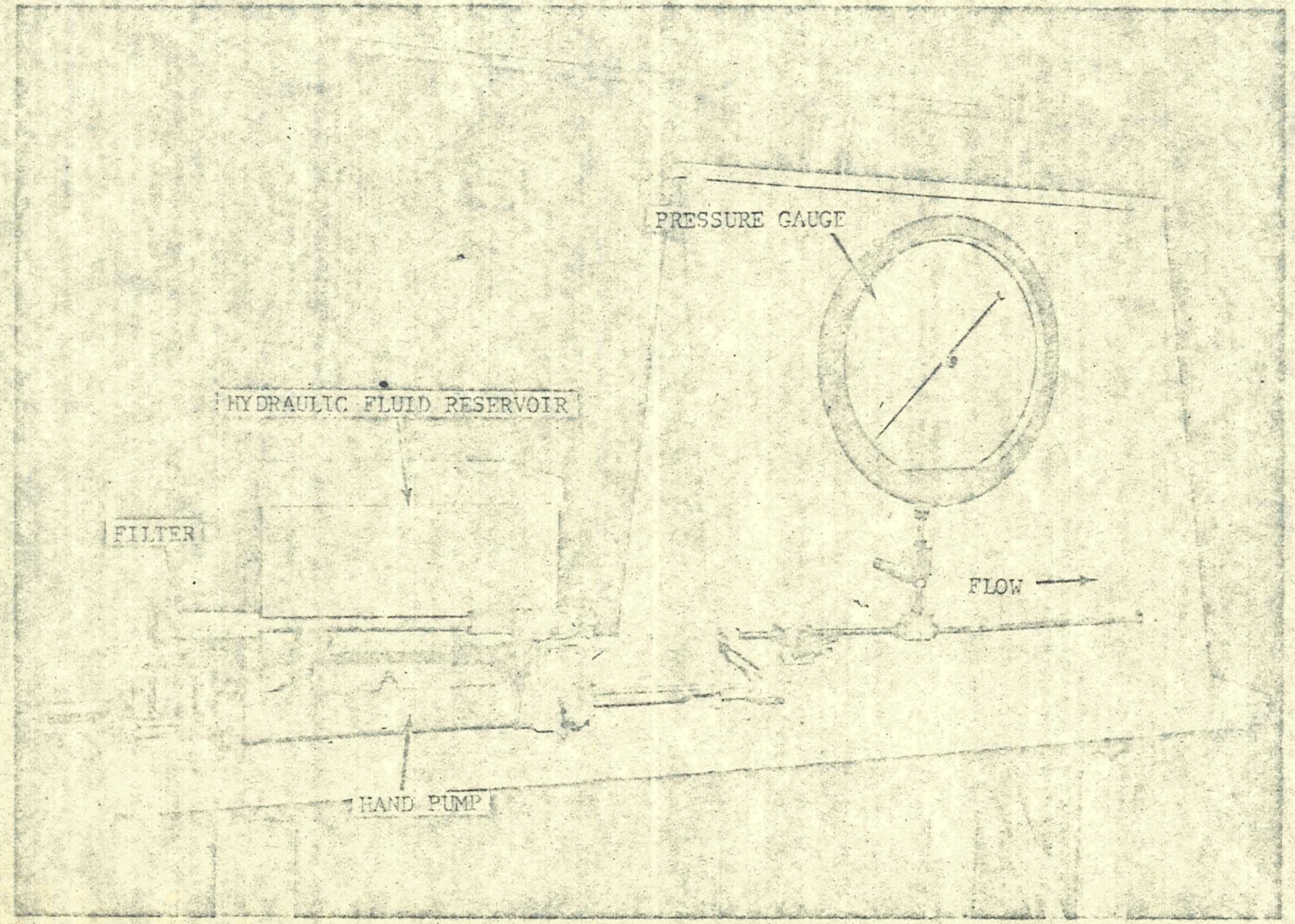
PHOTOGRAPH 13

LIFE CYCLE TEST SETUP

DOUGLAS AIRCRAFT MODIFICATION DIVISION

DAC 56182

FILM T-33303



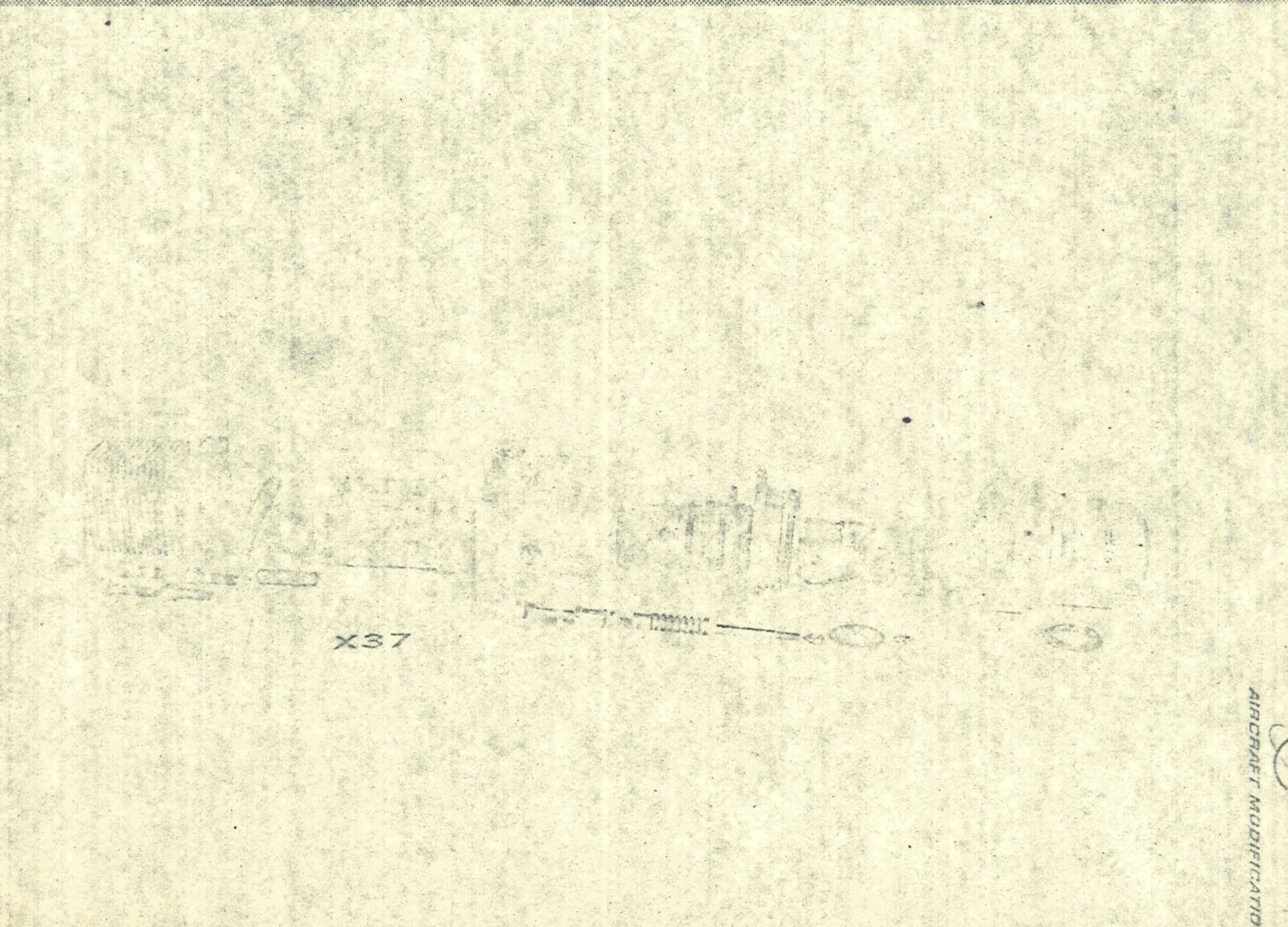
BURST TEST PRESSURE PANEL

PHOTOGRAPH 14

DOUGLAS
AIRCRAFT MODIFICATION DIVISION

DAC 56182

FILM T-37646

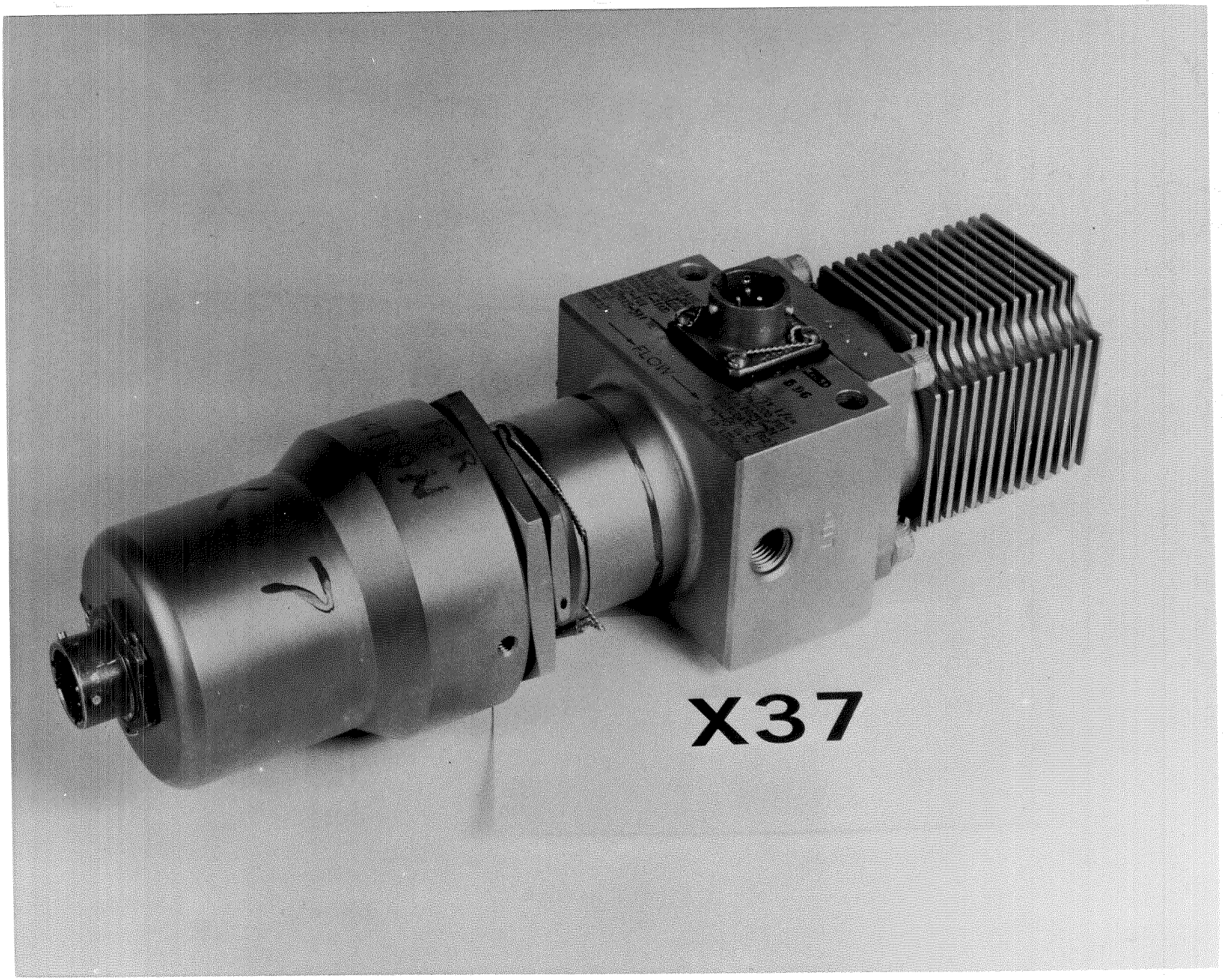


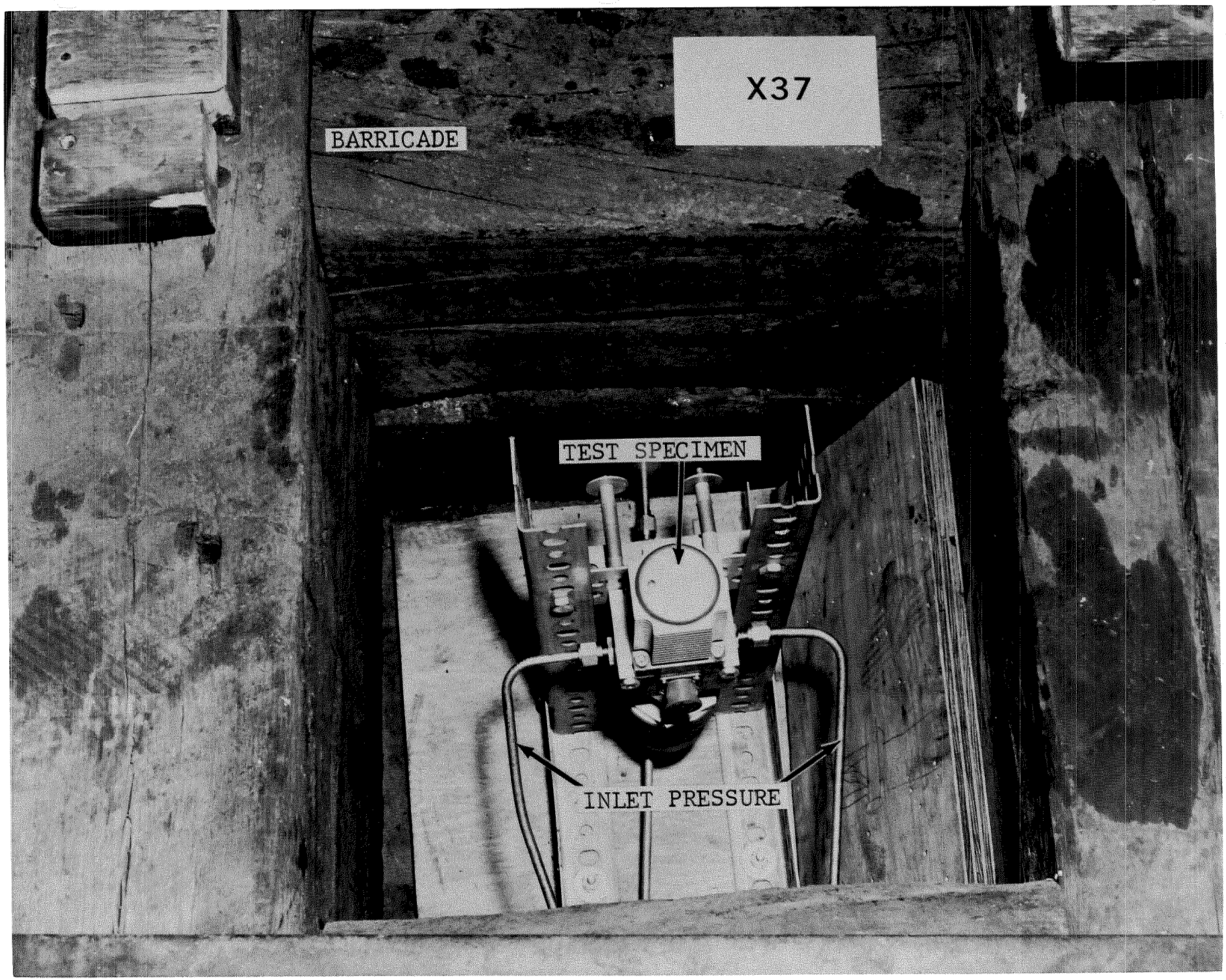
SPECIMEN DISASSEMBLED

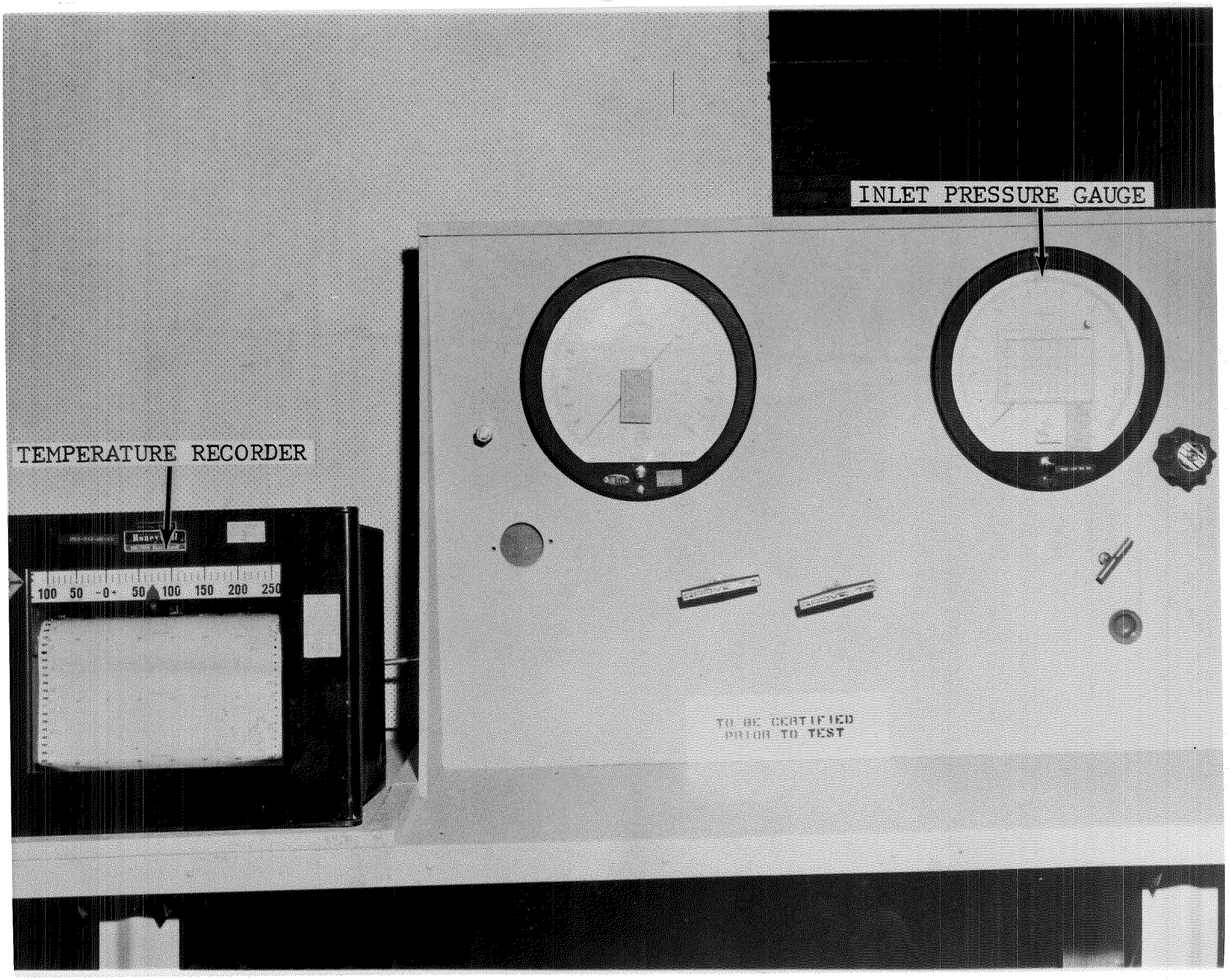
PHOTOGRAPH 15

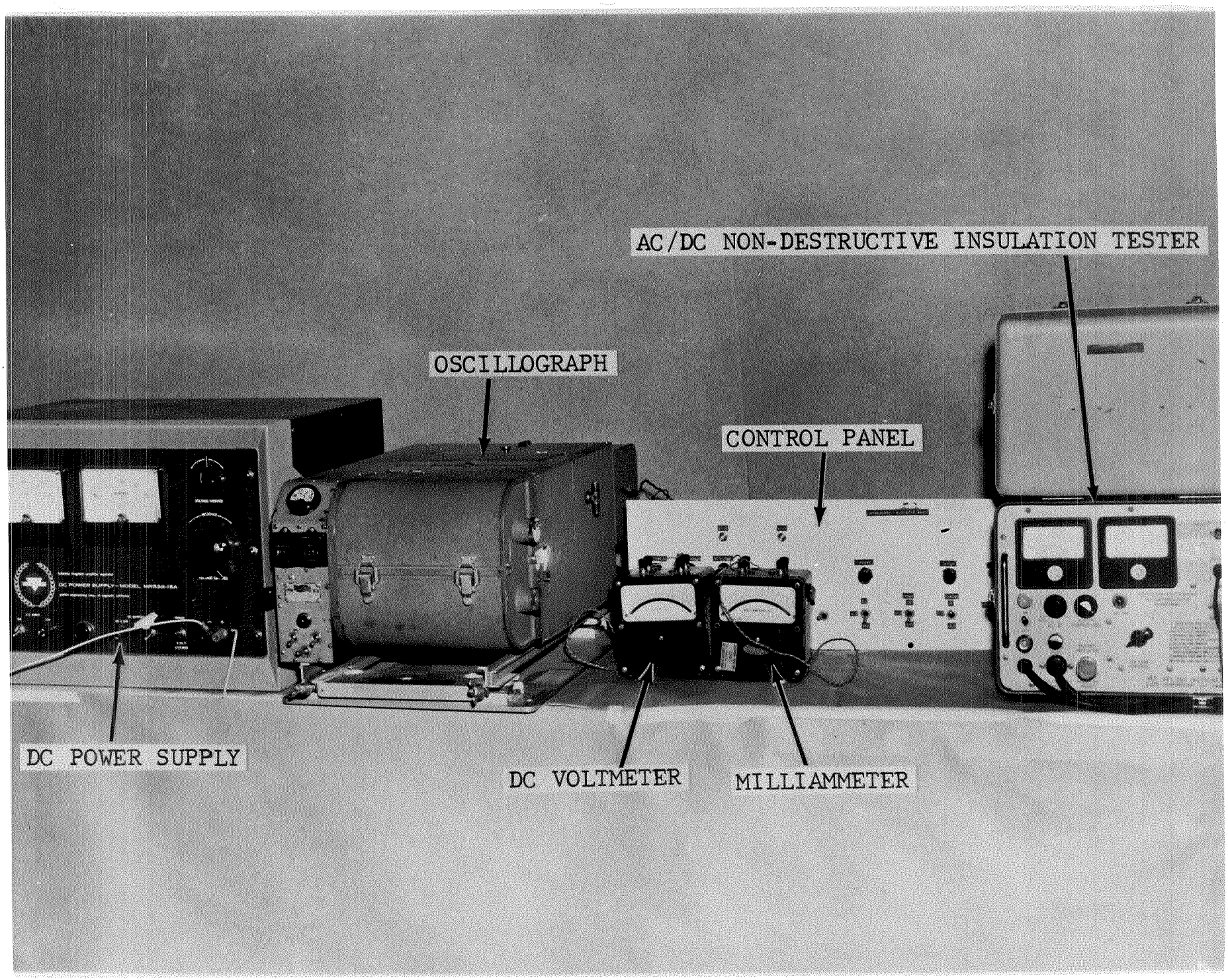
DOUGLAS AIRCRAFT MODIFICATION DIVISION

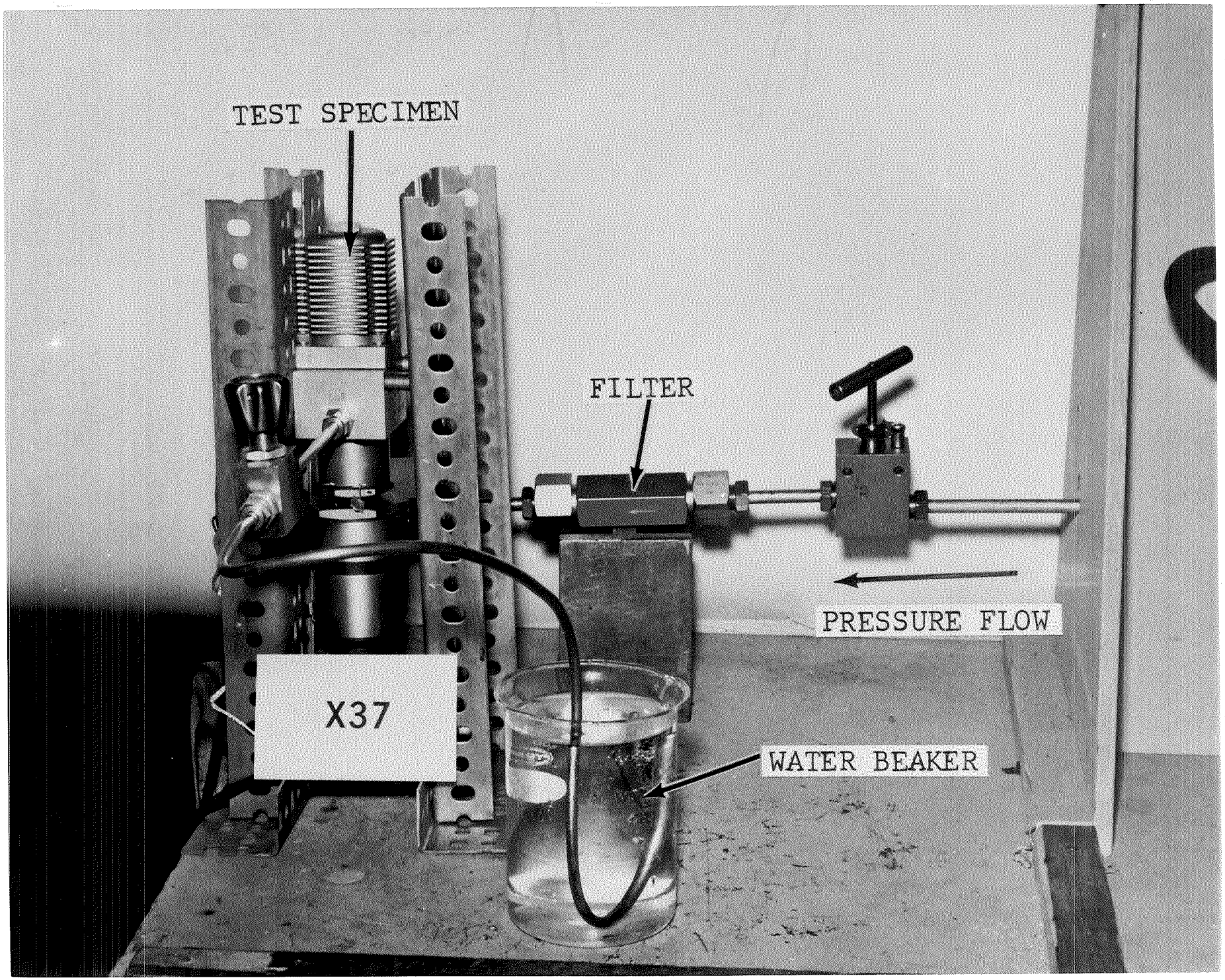
DAC 56182

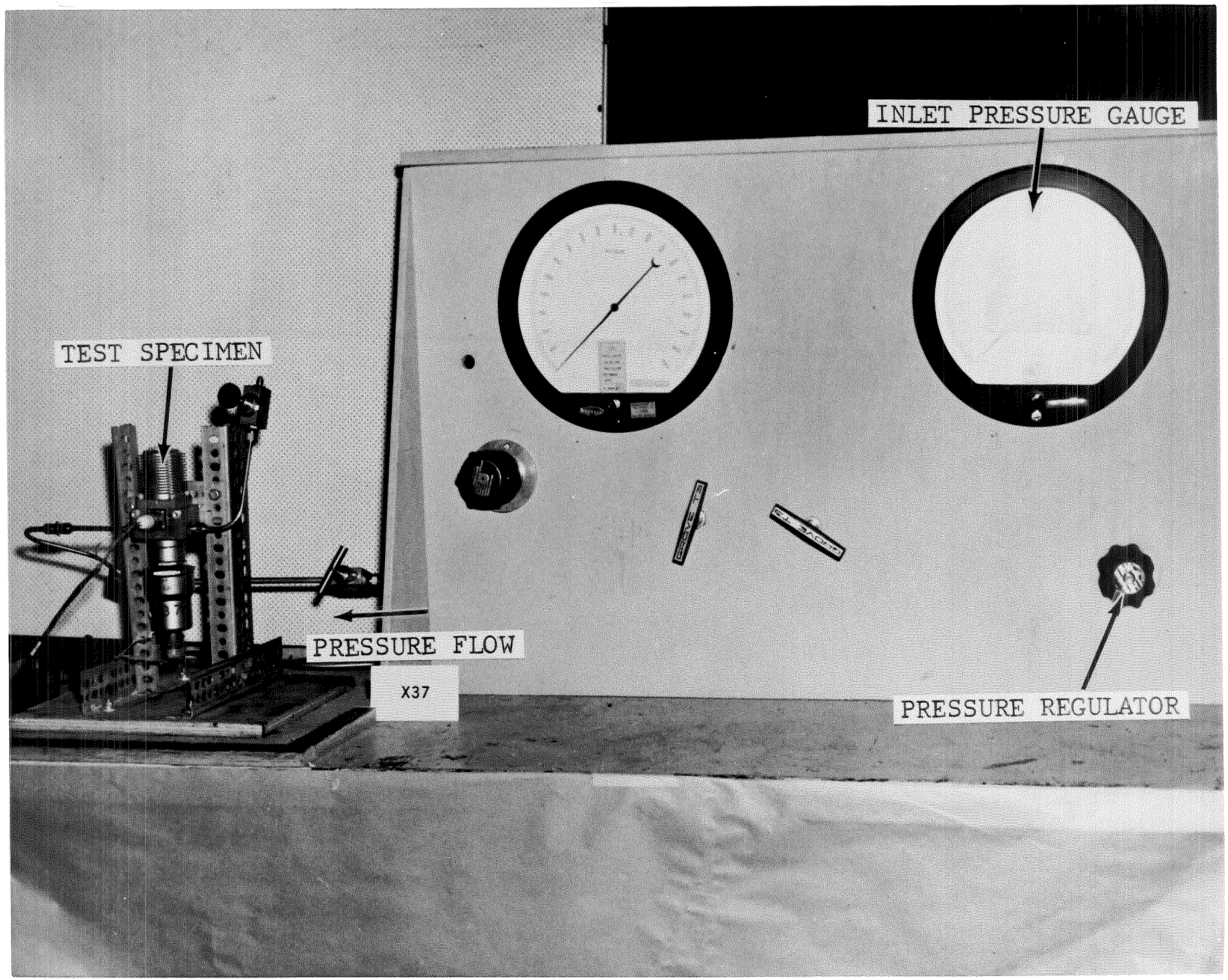

X37

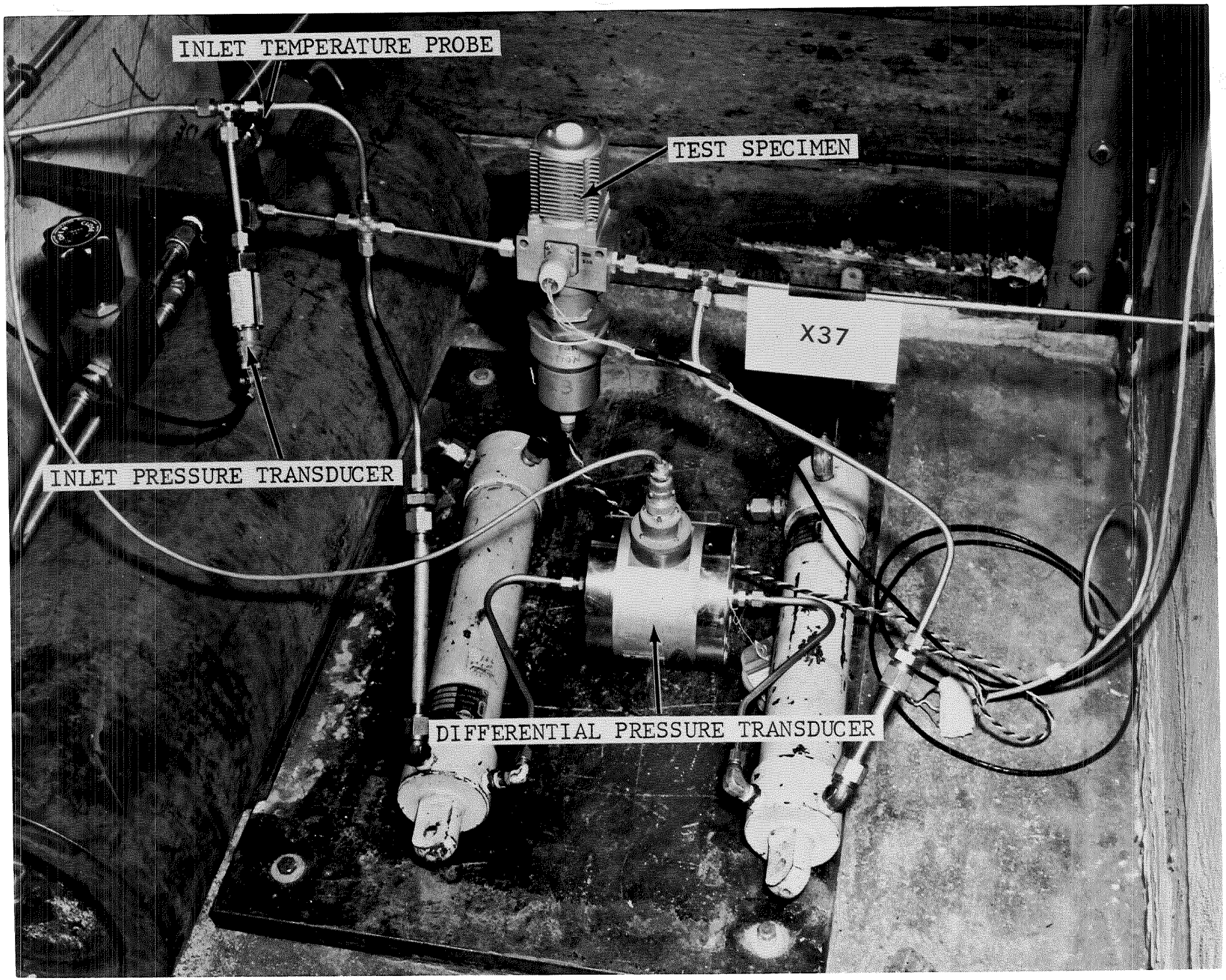

X37
BARRICADE
TEST SPECIMEN
INLET PRESSURE

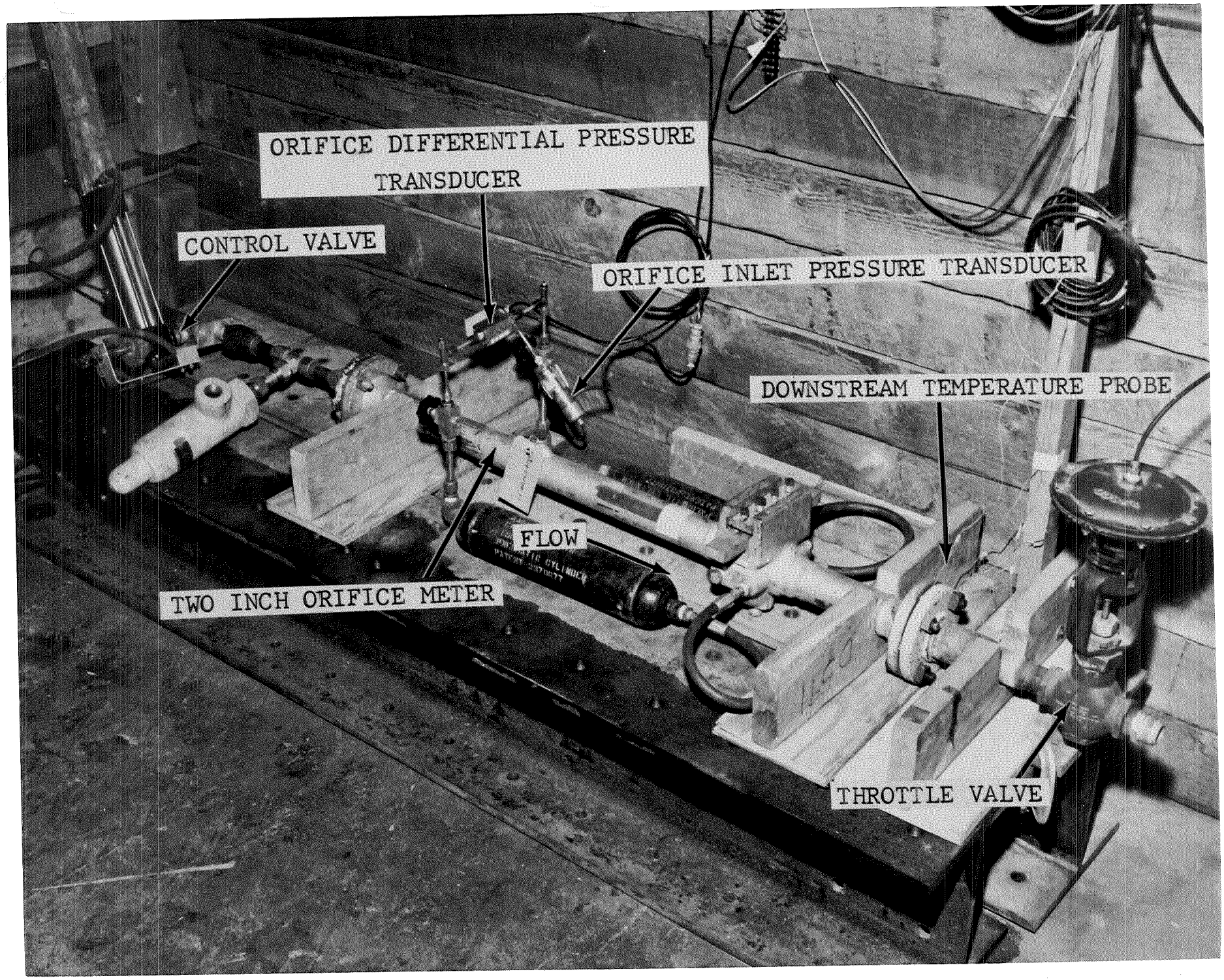

INLET PRESSURE GAUGE
TEMPERATURE RECORDER
100 50 -0- 50 100 150 200 250
TO BE CERTIFIED
PRIOR TO TEST

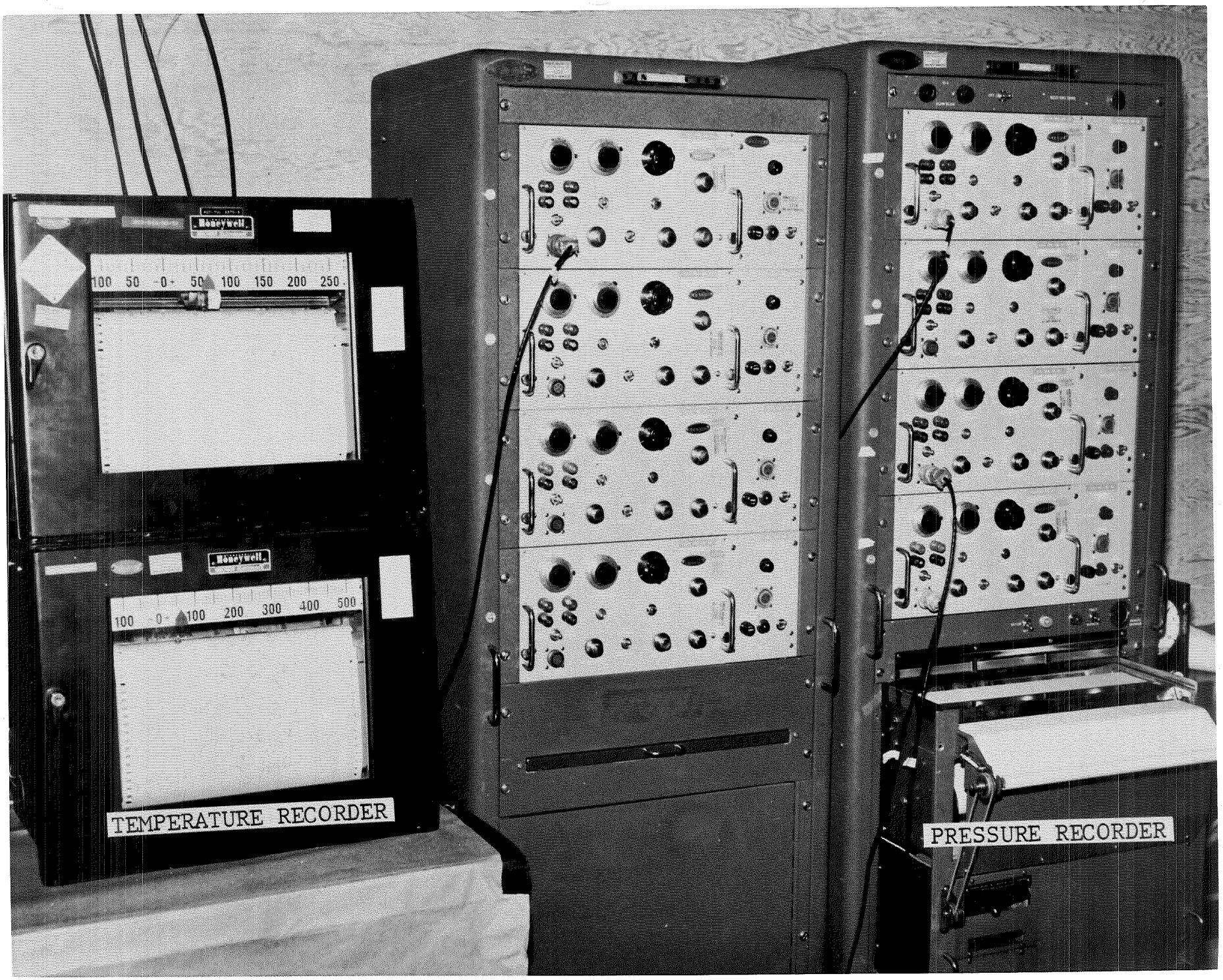

AC/DC NON-DESTRUCTIVE INSULATION TESTER
OSCILLOGRAPH
CONTROL PANEL
DC POWER SUPPLY
DC VOLTMETER
MILLIAMMETER

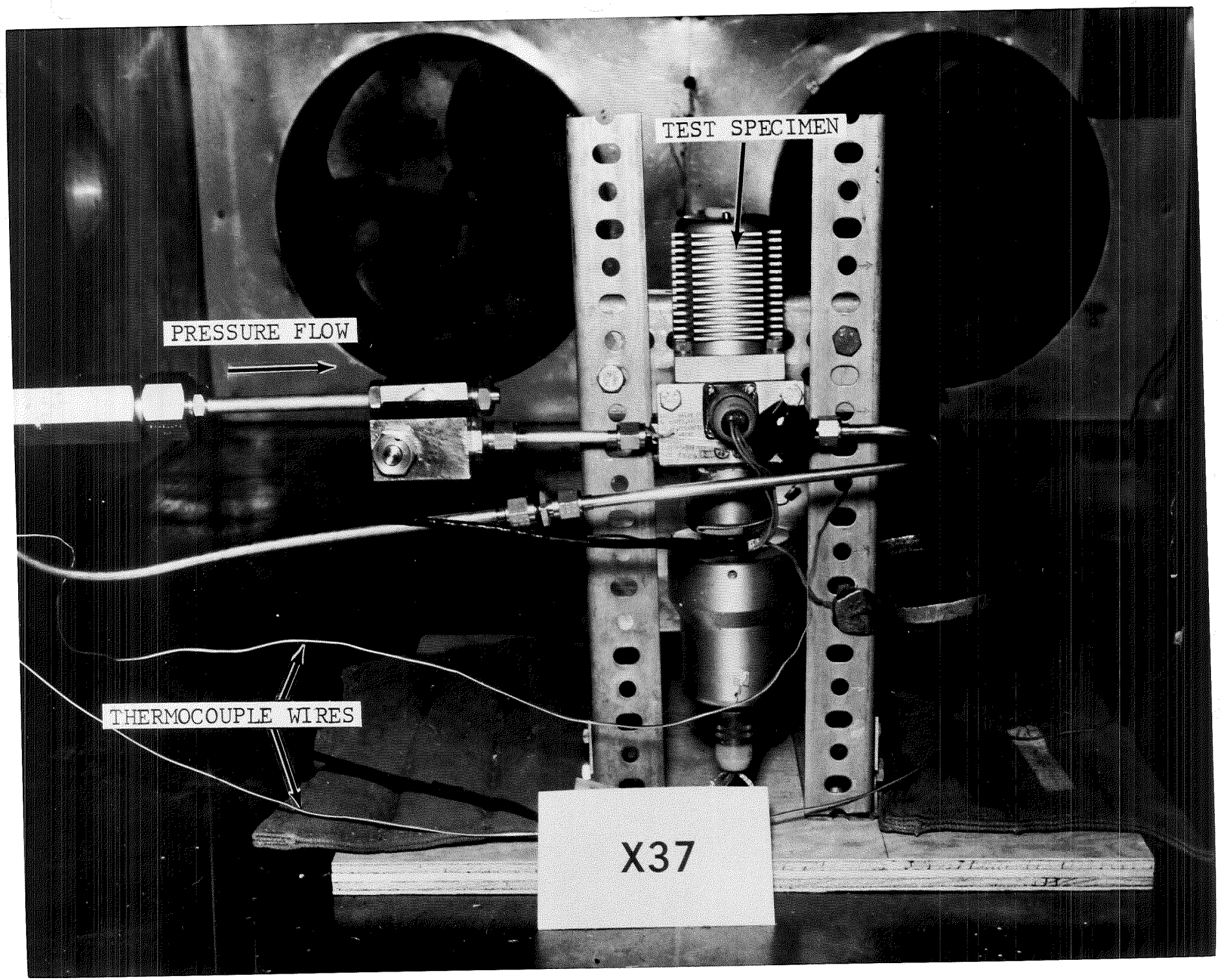

TEST SPECIMEN
FILTER
PRESSURE FLOW
X37
WATER BEAKER

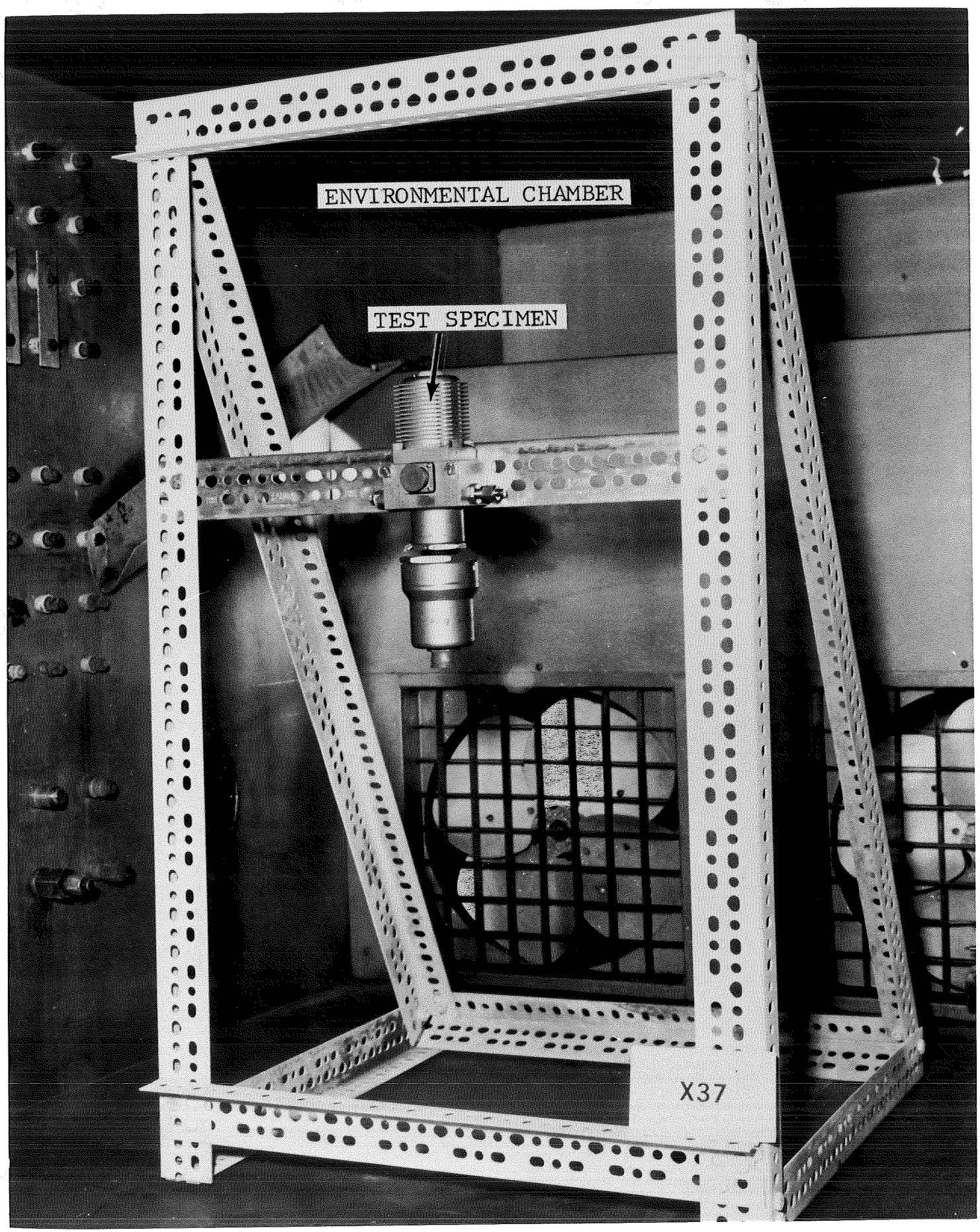

INLET PRESSURE GAUGE
TEST SPECIMEN
PRESSURE FLOW
X37
PRESSURE REGULATOR

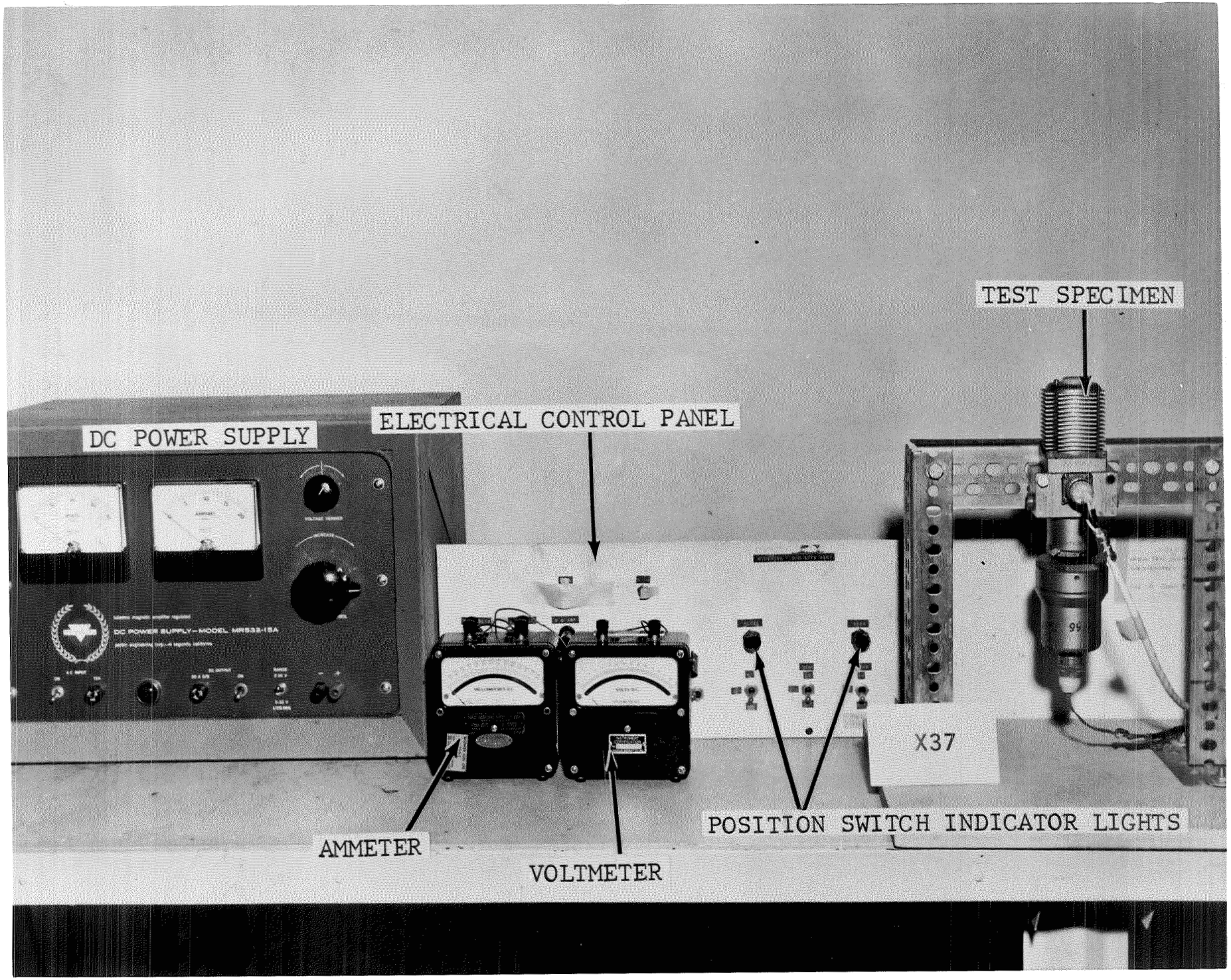

INLET TEMPERATURE PROBE
TEST SPECIMEN
X37
INLET PRESSURE TRANSDUCER
DIFFERENTIAL PRESSURE TRANSDUCER

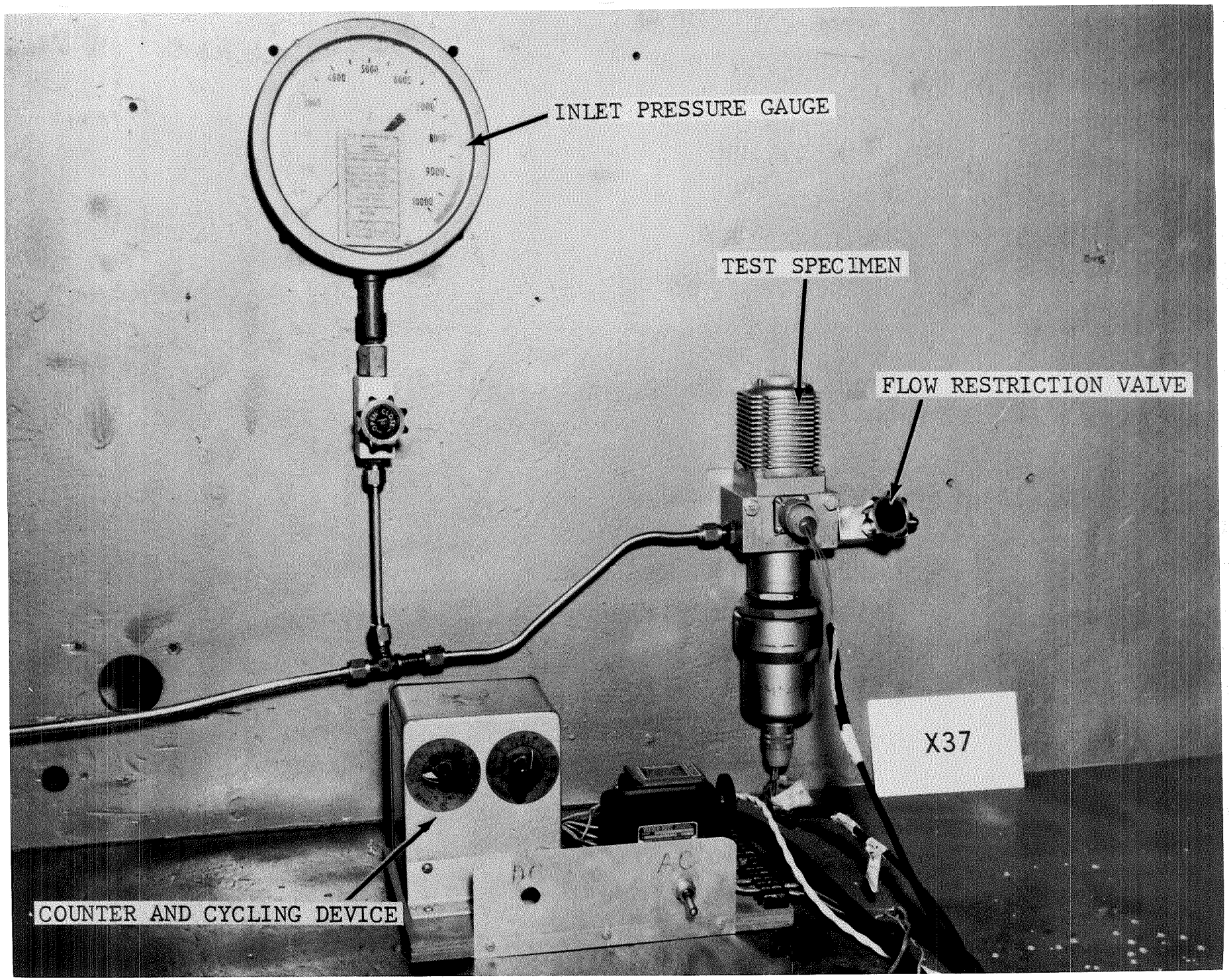

ORIFICE DIFFERENTIAL PRESSURE TRANSDUCER
CONTROL VALVE
ORIFICE INLET PRESSURE TRANSDUCER
DOWNSTREAM TEMPERATURE PROBE
FLOW
TWO INCH ORIFICE METER
THROTTLE VALVE

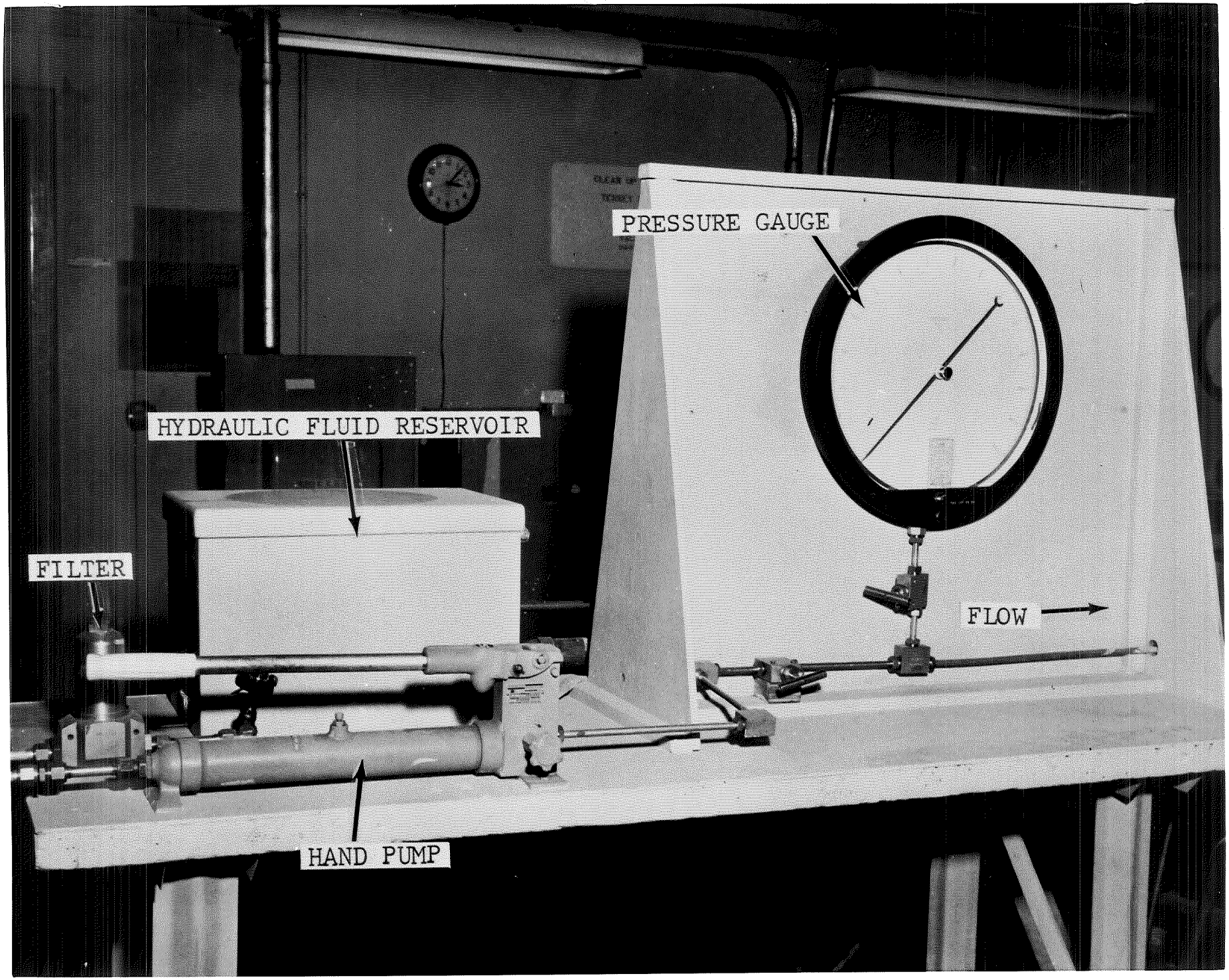

Honeywell
100 50 0 50 100 150 200 250
Honeywell
100 0 100 200 300 400 500
TEMPERATURE RECORDER
PRESSURE RECORDER

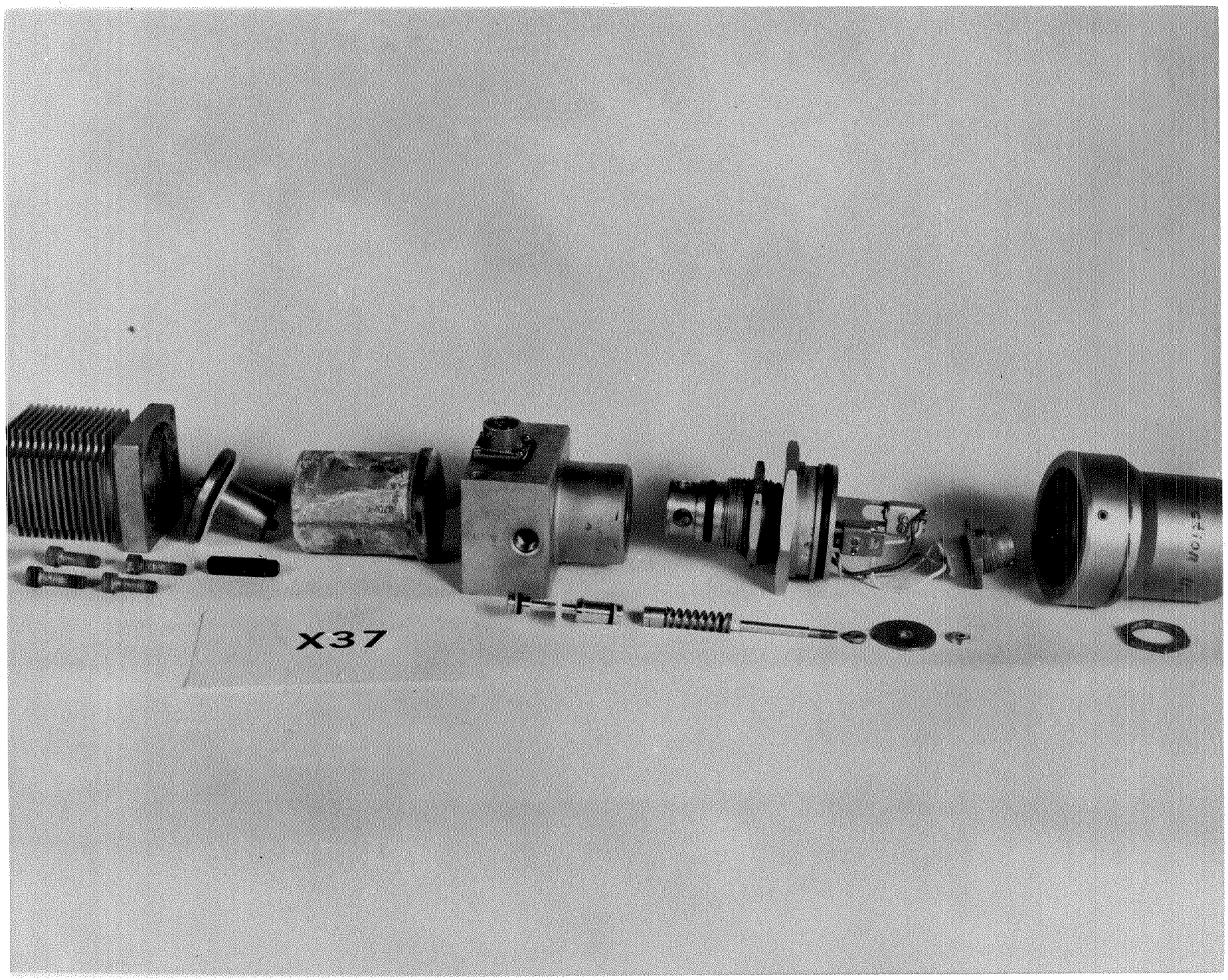

TEST SPECIMEN
PRESSURE FLOW
THERMOCOUPLE WIRES
X37


ENVIRONMENTAL CHAMBER
TEST SPECIMEN
X37


TEST SPECIMEN
DC POWER SUPPLY
ELECTRICAL CONTROL PANEL
X37
AMMETER
VOLTMETER
POSITION SWITCH INDICATOR LIGHTS


INLET PRESSURE GAUGE
TEST SPECIMEN
FLOW RESTRICTION VALVE
X37
COUNTER AND CYCLING DEVICE
D.C
A.C


PRESSURE GAUGE
HYDRAULIC FLUID RESERVOIR
FILTER
FLOW
HAND PUMP


X37

FORM 850-2 (11-66)

douglas	DOUGLAS AIRCRAFT CO, INC. MISSILE & SPACE SYSTEMS DIVISION SANTA MONICA, CALIFORNIA	QUALIFICATION STATEMENT	[X] DE/Q TEST [ ] FORMAL QUAL

PROGRAM: Saturn	TEST PLAN AND ITEM NUMBER: SM 41412 X-37
TEST PLAN LINE ITEM TITLE: 6000 psig, 1/4 INCH, SOLENOID VALVE	PART NO. 1A69815-517
TECHNICAL MEMORANDUM NUMBER(S): DAC Report 56182, dated 1-24-67	

ENGINEERING RESOLUTIONS AND CONCLUSIONS

Testing was performed per Test Control Drawing 1T00432 "J". The test results obtained and presented in the attached report are not totally conclusive. As will be noted, several test anomalies were recorded. Electrical and response time anomalies were attributed to a thermal expension of the Micarta Push-Rod. The push-rod was modified and the unit was re-identified as 1A69815-517. The remaining test anomalies were attributed to inadequate vendor quality control which has subsequently been corrected. Furthermore, this type unit and its various other configurations have performed satisfactorily in numerous applications in models DSV-4B-432 and 433 during launch operations of Saturn 201, 202, 203, 204, 501 and 502. The design and fabrication concepts of this valve have been further proven as evidenced by satisfactory completions on similar line items such as X-30C, X-30, X-38 and X-124.

(USE CONTINUATION SHEET AS NECESSARY)

STATEMENT OF QUALIFICATION

Based on Qualification Test results presented in the attached report, the successful usage of this type unit in the field and by its similarity to other qualified valves as noted above, it is the conclusion of the Douglas Aircraft Company, Inc., that the above item is qualified for use as intended with the Saturn S-IVB.

DESIGN TECHNOLOGY	RELIABILITY ENGINEERING	PROJECT OFFICE-TEST
4-16-68 for D. D. Hofferth Chief Engineer Saturn Propulsion	N/A N. Feldman SAT/STRENGTH 4-19-68	4-16-68 L. B. Mitchell

DOUGLAS
AIRCRAFT MODIFICATION DIVISION

ADMINISTRATIVE DATA

TEST TITLE: Qualification Test - Solenoid Valve, 1/4-Inch 6000 PSIG, DAC P/N 1A69815-517, Rev. AB

TEST COMPLETED: December 14, 1966

DISPOSITION OF TEST SPECIMEN: Tulsa storage for 120 days after test completion. Final disposition to be made by A3-860.

REFERENCE INFORMATION:

Santa Monica		Tulsa	
EWO:	27467	EWO:	90288
TCD:	1T00432 "J"	WRO:	DSV-4B #78
TPI:	X-37	S.O.:	5779-6305
SM 41412		DTP:	1T02101 "G"
		ETO:	5811

REPORT DISTRIBUTION: Original and eight copies to
Saturn Program Coordinator, D-260
R. P. Talbott, D-260
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Reproducible to D-260 Vault

FORM [illegible]-61TC (REV. 4-58)